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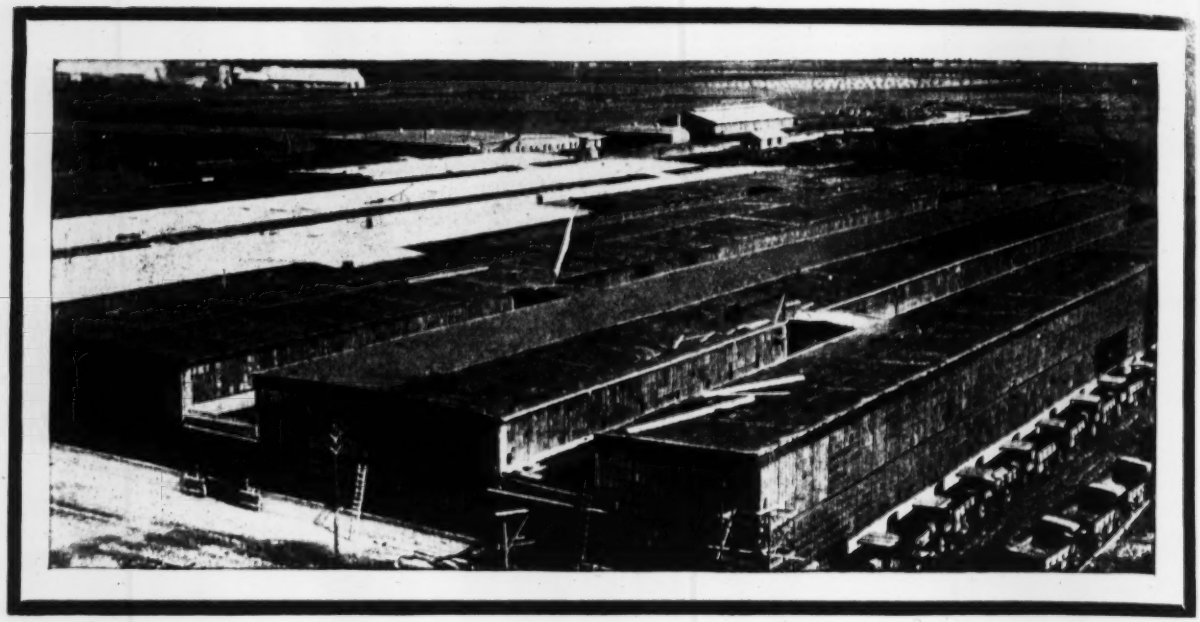
Grand Central Development Seen as Great Civic Center
(With Special Insert)
New York Passenger Terminal and Adjacent Property Surpassing Expectations as Unit Including Depot, Post Office, Hotels, Office Buildings, Apartments, Clubs and Stores—Use of "Air Rights" above Tracks—Power and Service Units

Chicago Bascule Bridge—Design and Operating Features
By Hugh E. Young



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Competition for Jobs

IS LABOR shortage coming to an end? The question is suggested by the recruiting of 3,000 men from other towns to run the cars and trains of the Brooklyn (N. Y.) Rapid Transit Company, whose employees are on strike. A year ago such a force could not have been recruited except at wages that no manager of a property would have dared to pay. He would have had to bid for men already employed. The recruits now are men out of work; factory hands mostly, coming from plants which have shut down. No one enjoys the prospect of seeing men out of work, but unemployment seems to be the necessary remedy for the present situation. Unlimited power always leads to excesses. Labor has had it in recent years, and there has come the crying abuse of loafing, of lowered production. With decrease in demand for workers that unlimited power will be lost. Competition for worth-while places will bring workmen to their senses and we shall get on an upward course again. The Brooklyn experience indicates that the remedial process is beginning.

Program for Railroad Efficiency

FOLLOWING charges recently made before the Senate Reconstruction Committee that the railroads were chiefly to blame for the housing shortage as a result of embargoes against building materials, the construction industry as a whole will take a lively interest in the ambitious program of the Association of Railway Executives for greatly increasing railroad operating efficiency. The operators frankly recognize that shortage of equipment cannot be made up for so long a time that relief must be sought in the more effective use of existing cars. To this end a program has been launched to bring daily freight car movement up to 30 miles and the loading up to thirty tons, with reduction of bad-order equipment to a minimum. The importance of this program may be realized from the fact that if its aims were attained there would result an increase of more than forty per cent in the carrying capacity of our railroads. To this end the railroad managers are seeking the co-operation of shippers and consignees and their efforts appear to be meeting with response. We believe that the seriousness with which the leading railroad operators of the country have undertaken this program is significant not only because of the possible results but because it is expressive of the conviction that private operation is on trial for its life and that the question of outright Government ownership is by no means dead. Such sentiment may have served as a background for the unprecedented request of railroad interests, recently made to the Interstate Commerce Commission, for a reduction of shipping rates on the Lakes as a means of diverting rail traffic to the waterways. There appears no doubt that railroad managers are making a supreme effort to give something that approaches adequate service, even with the shortage of available facilities.

Lack of Co-Ordination in Civil Engineers' Amendments

AS POINTED out and emphasized at the meeting of the American Society of Civil Engineers in New York last week, the amendments to the constitution sent to letter ballot by order of the Portland convention were not studied with reference to the constitution as a whole. If adopted, at least one other amendment to the constitution will have to be made, another section will need reconsideration, while the status of certain nominees for office becomes, so some believe at least, debatable.

The clause requiring that 25 votes must be cast in the board of direction to constitute an election to membership in the society must be changed if there are to be only 24 members of the board, as one of the amendments provides.

The provision that three members of the finance committee and two members of the library and of the publication committee shall be from District 1 will need to be reconsidered. Otherwise two of the New York directors, under the amended constitution, would be on all three committees and the other one on two—rather a heavy assignment. Against a change of this provision is the solid argument that for effectiveness committees should have strong representation in the headquarters' city.

The alleged debatable question will arise over the status of the two nominees recently named, but not announced, for New York directorships. If the amendments carry, they become effective Nov. 6. The offices for which these nominees are named would, accordingly, be abolished upon the expiration of the terms of the present incumbents.

Should the names of these nominees be put on the ballot, nevertheless? If so put, what would be their status if votes were cast for them? Obviously, a man cannot be elected to an office that does not exist, and votes cast for the placeless ones could hardly be construed as resurrecting the abolished directorships.

At the New York meeting much was made of this possible confusion and of the lack of agreement between the possible future number of directors and the number of votes required to elect to membership. The failure to co-ordinate the proposed amendments with the existing constitution is, of course, regrettable and an evidence of lack of that care which the changing of so important a document merits, but the speakers at New York overdrew, we believe, the seriousness of the situation.

An amendment regarding the number of votes required for election to membership could be adopted by March. The status of the New York nominees may

furnish the basis for debate if one wants to split hairs, but the fundamental principle appears to be clear. The heavy committee assignments of New York directors need not be considered as a serious element affecting the disposal of the amendments.

Some of the other argument advanced at the New York meeting is worthy of far more serious consideration than these regrettable lapses in co-ordination.

At the End of the Controversy

FOR two years the American Society of Civil Engineers has been a battleground of reorganization. The fight has waxed hot and, at times, acrimonius. As a result of the discussions, the society has arrived at the point of decision. There has been crystallization in two chief directions—toward a strengthening of the local sections and a democratization through a new method of electing officers. A vote on the enabling amendments is being taken. During the same period the federation idea has grown strong, and the society very soon is to vote on that, too.

Certainly on the federation it will be the last word. If the amendments fail, the alternatives in the hands of a committee will have to be considered at the annual meeting. They have, however, the general purport of those now submitted to ballot.

No matter, then, what the result of the ballot on the amendments, we are measurably near the termination of the long-drawn-out discussions—for which, the *Engineering News-Record* feels sure, the membership will be duly thankful. We have been "fed up on" discussion, we are growing tired of controversy, we should like to get to work and direct our energy into productive technical lines. We have given much thought and time to machinery and methods; now we would like to make the machine run. Soon there will be a machine of some kind, and even those who will be disappointed will be called upon to get aboard and help. If we will devote in the next two years to earnest technical work as much time and energy as we have given to controversy the society will progress rapidly, no matter if the machine should lack perfection.

In expressing this desire for peace and whole-hearted co-operation between all parties, the *Engineering News-Record* believes it is expressing a view widely shared by the members. Conciliation and counsels of co-operation usually come after a controversy is entirely finished, but we believe that it is well to prepare for the event. While using the utmost efforts to present their respective sides during the month that remains for balloting, we believe that the society will be the gainer if every member resolves to himself that even if he is disappointed he will put himself whole-heartedly into the work of sending the American Society of Civil Engineers ahead at a good, safe speed. It is a great organization, one that every member is proud of. Despite what may have been said in the heat of controversy, every member realizes its institutional character, and is honestly desirous of making it greater. As to the means, there is disagreement. If, however, we stick to the principle of maintaining the society's prestige while bettering its work we shall be on safe and common ground.

For maximum effectiveness, every member needs to give the society his full support. We face, if you will, an era of reconstruction in the society itself. For two years we have given little thought to its technical work. It has a financial difficulty to solve. Its publication committee is asking for a study of the problem of the *Proceedings*. Special committee work is at a low ebb. Is there any doubt that the society right now needs the best thought and work of its entire membership?

In advance of the counting of the ballots it would be an act of loyalty that the society deserves to promise it, within one's own heart, unqualified support no matter what the result.

The Grand Central Terminal—A Great Civic Development

Due to the constantly increasing land value of railway passenger terminals in the larger cities, the intensive development or utilization of these areas is of growing importance in railway economics. The most striking example of such development is the Grand Central Terminal in New York City, treated elsewhere in this issue. The very high land values justified not only the fullest development of the terminal buildings for offices, but the utilization of areas over the tracks for building purposes. This, indeed, is an extreme case; the great expense of such treatment would be justified only at a few passenger terminals here and abroad.

The term "Grand Central" no longer designates a mere railroad station, but a large and impressive civic center. The story of its development in the last twenty years is a romance. Where there were formerly smoking tracks and four-story buildings, there are large handsome structures—office buildings, stores, hotels, apartments and clubs. The terminal area itself, because of its attractiveness, has become the heart of a still greater development, radiating from it in every direction. In fact, the whole surrounding neighborhood now goes by the name of the Grand Central District, and is one of the chief business centers of the metropolis. As a civic as well as a railroad-terminal development, it is unique and stands as a monument to the foresight and ability of the New York Central's officers.

Reference to the remarkable development of the Grand Central area prompts some thoughts on the economic use of railroad terminal property. The New York Central's solution has been eminently successful and points the direction for terminal studies in other cities where land values are high.

Apparently, though, there is a wide difference of opinion as to the desirability of high or low buildings over both passenger stations and freight houses. The European custom of building hotels as a part of the station has gained little headway here. In New York the headhouses of the two great terminals represent the low type, although that of the Grand Central is built to carry a high office building. Of two modern terminals in Chicago, one has a skyscraper office building, while the other has a low headhouse of greater architectural pretentions, with the railroad offices in a separate building. In the case of freight terminals, the upper floor of the freight house is sometimes used for temporary storage, but in many cases it would seem advantageous to cover the site with a tall building having upper floors for warehouse or other purposes. The freight house of a terminal now under construction in Chicago will be surmounted by the general offices of the railway company. Nowhere in this country have

large hotels in connection with railroad passenger terminals been developed as at New York. Beside those in the Grand Central area, the Pennsylvania Hotel, opposite the Pennsylvania Station, is on railroad property and is connected to the station.

The possibility of producing revenue necessarily depends on local conditions. In New York the tide of business uptown helped the Grand Central situation materially, though the attractiveness of the terminal area itself accelerated the general uptown movement. The electrification was another favoring factor—a *sine qua non* of the whole scheme. In other large cities electrification would change the character of the adjacent areas so much as to invite elaborate development. With steam operation a railroad passenger yard or even the approach to a terminal is anything but attractive for high-class buildings.

While an imposing low-headhouse terminal is an excellent city adornment, the inclination of railway operators, with land values climbing, must perforce be directed to the most economic use of the areas available. In such studies the Grand Central solution is full of suggestion.

A Field for Experiment

WHEN a loaded motor truck pounding along the road at 15 or 20 miles an hour strikes a country highway bridge and bumps violently over its uneven floor the effect on the bridge obviously exceeds that of the same truck at rest. Unfortunately we do not know what the excess may amount to, especially under the unfavorable combinations of rough pavement and jolting truck that sometimes occur. In the absence of experimental data, the builders of highway bridges generally content themselves with ignoring the effect, or at most, whether flat or graduated (one state highway department uses 30 per cent) of a fixed fraction of the impact ratio customary in railroad bridge design.

In a proposal that steps be taken to increase the safety of highway bridges, made in these columns two weeks ago, the impact effect was referred to, but without mention of the fact that the effect has not been measured and that therefore we know practically nothing about it. The subject not only possesses technical interest independent of the matter of settling on bridge-design loadings, but under present-day service conditions it constitutes a practical problem of immediate importance. It ranks among the leading questions for experimental investigation in the whole field of bridge engineering.

Bridge impact under railroad trains has been measured in several series of elaborate experiments. From these it is known that although a train rolls smoothly along on steel rails yet in its progress across a bridge it gives rise to very considerable stresses superadded to those produced by the mere weight effect of engine and cars. This added stress has been discussed extensively, and several elaborate formulas have been devised for computing its amount for the various members of both long and short spans. Extra metal is provided in all new railway bridges to resist the impact stress. But these data and practices plainly have no meaning for highway bridge design, and it is therefore only natural that, lacking the results of actual measurements, designers of highway bridges have little respect for impact formulas.

Beyond doubt impact effects occur in highway bridges just as frequently as in railway bridges. But if we do not know their amount we cannot provide for them. So long as they remain unprovided for, they necessarily infringe to an unknown degree on the safety margin of the structures; in other words, impact tends to bring our highway bridges nearer their breaking-down point.

It is not impossible, moreover, that measurement would show abnormally high impact in highway bridges under some conditions. According to current notions, derived from railroad bridge service, impact effects range between zero and 100 per cent; in other words, the effect of a moving load is generally much less than twice the static effect of the same load. But can we safely assume that this would be the case in highway bridge service? On a rough floor, especially the worn planking of a medium-span road bridge twenty-five or thirty years old, a heavy truck moving at high speed has every chance of delivering violent blows to the structure. Impact additions of quite excessive amounts, compared with present conceptions, might then be produced. This possibility is a strong argument for the proposal that experimental study of impacts be undertaken.

To summarize the case: It will not be possible to estimate the capacities of highway bridges satisfactorily, or to construct new bridges with due economy and efficiency, until the impact effects occurring under motor trucks at speed are measured. The importance of this problem, its difficulty and its cost, warrant the suggestion that the highway departments of a number of states join in undertaking the investigation; their combined resources, together with those of the Bureau of Public Roads at Washington, would enable the study to be taken up on a scale proportional to the task.

Plainly, such study must be directed first of all toward getting a practical estimate of commonly occuring impact values, in order that at least rough data for judging of the safety of bridges may be available. But the work is by no means ended here. As the next step it will be necessary to determine how impact varies with speed. Few if any data on this phase of the subject have been obtained in railway bridge experiments, and in any case the conditions are so different in highway service as to make the question a new one. Roughly, perhaps, an increase with the square of the speed is to be expected, in view of the direct blow and shock effect forming part of the live-load action on a highway bridge. Whether the existence of critical speeds, observed in railway bridge experiments, would complicate the problem is an open question; but if there is such a thing as critical speed in highway bridge service it is likely to be not a fixed quantity but a variable, depending on the particular vehicle and its path across the bridge.

Maximum impact effects doubtless occur in the floor members. Since the floors of old highway bridges are also the most seriously overstressed under static loading, the rapid growth of truck traffic in the absence of load and speed control makes impact a question of very immediate moment. It is certain that, to maintain old bridges in reasonably safe service, many floors must be reinforced in the near future. Only through measurement of impact effects will it be possible to execute this reinforcement in such a way as to provide adequately for the action of traffic loads.

HYDRAULIC FILL at the MIAMI CONSERVANCY DAMS

by C. S. HILL
ASSOCIATE EDITOR
ENGINEERING NEWS-RECORD

Part I

Study and experiment applied to the hydraulic fill operations of the Miami Conservancy District have developed:

(1) A manganese steel centrifugal pump which, compared with cast iron, has doubled the output life of pump shells and increased nearly tenfold the output life of pump runners.

(2) A new design of pump shell in white iron that has exhibited a resistance to wear which indicates an output life of 400,000 cu. yd. of heavy gravel and sand fill, or about double the life of a manganese steel shell under the same conditions.

(3) A high carbon steel, welded dredge pipe which has an output of four times the yardage of ordinary riveted steel dredge pipe.

(4) A sump and pump layout which eliminates priming and has materially reduced the loss of head at the suction.

(5) A practicable self-cleaning grizzly for screening heavy pit run glacial drift.

(6) Electric signaling systems which provide the pump operator with accurate knowledge of the conditions of flow in the pipe-line system and enable close synchronization of main pump and booster pump operation.

Combined with these outstanding developments there have been improvements in minor details of practice which give the work in the Miami River valley, besides its rank as the largest hydraulic fill dam construction operation in the world, a technical standing of significance to construction engineers and to contractors. From a careful personal study by the editor, corrected by the engineers of the Miami Conservancy District, a review of hydraulic fill practices and developments is given in a series of three articles.—EDITOR.

STRUCTURALLY the five dams which will protect the Miami River valley from floods are earth embankments pierced by outlets of concrete masonry. The embankments are being built by the hydraulic fill method. They vary in volume from about 865,000 to 3,500,000 cu.yd. and aggregate about 9,000,000 cu.yd. Each operation is a separate construction task involving individual problems of stream control, sequence of fill, borrow-pit development, transportation and plant layout. The common technical direction of the five operations and their simultaneous prosecution permits, however, the standardization, to a considerable degree, of processes and equipment.

General Conditions.—So far as it may be disclosed by dimensions and plans the construction required is indicated by the drawings of Fig. 1. As affecting the hydraulic fill operations certain characteristics of structure require attention. At two dams the outlet and the spillway are separate structures and the embankment is continuous across the valley, which complicates the problem of stream control, and at three dams the outlet and spillway are a single structure, which forms a notch in the dam and interrupts the continuity of the embankment, thus complicating the filling operations. Another influencing factor is the extended lateral dimension and the comparatively restricted heights of the fills. Referring to Fig. 1, and equalizing the horizontal and vertical scales, it is observed that except at Germantown the dams are wide flat fills across broad level valleys.

The geology of the dam locations also assumes importance in the construction problem. It has to be considered not merely in respect to securing safe foundations for the dam structures but also in respect to developing sources of materials suitable for hydraulic fill embankment and for concrete outlet construction. The valleys in which the dams are located are glacial drift overlying rock. Below the surface this drift is gravel and sand which have been worked

over by the waters of the melting glaciers. On the surface there is an inundation deposit from later streams of glacial fill or fine rock particles, interspersed with clay. Generally speaking these materials properly selected and treated provide excellent aggregates for concrete, and when combined properly are equally, excellent materials for hydraulic fill dam embankment. Some irregularity of the glacial deposits in the distribution of coarse and fine materials makes it necessary at times to go to separate sources to obtain the desired combinations but invariably those sources are all reasonably convenient to the sites of the dams.

Construction of hydraulic fill, aside from administration, involved, then, the following principal problems: (1) stream control; (2) borrow-pit development and materials transportation; (3) pump construction and operation; (4) discharge pipe construction and (5) embankment building. Determination of some of the technical questions, such as hydraulic and mechanical design of pumps and the principles of core control and settlement, must await the completion of the records and their analyses, but the broad developments of practice which are of service to the contractor are capable of expression. They comprehend, as has been noted, a number of improvements of importance.

Stream Control.—The normal flood season of the Miami River valley is March and April. During the remainder of the year construction is usually unhindered by high water except when, by chance, a summer cloudburst causes a temporary freshet on the more flashy streams. This low-water period is during the winter season, when cold weather curtails progress.

Since the earth fill for each dam requires two or more construction seasons stream control and sequence of fill have to be planned with care that: (1) flood danger to downstream centers of population shall not be intensified by the dam construction operations and (2) when final closure by the fill of the original channel is undertaken it can be completed during the low-water season beyond danger of being overtopped by the succeeding spring floods. This danger point is set at a level which is safe in case of a flood as great as that of 1913.

While the problem of stream control at each of the dams is largely determined by the local conditions, among which is the type of outlet, it submits to a general principle of solution for all dams. This principle is construction of the fill in sections longitudinally of the dam as indicated by the series of diagrams making up Fig. 1. Inspection of these diagrams discloses: (1) that until the final closure is undertaken the natural clear-way for flood flow is not constricted and (2) that when final closure is undertaken it is completed in one season.

In a measure the complexity of planning stream control and sequence of fill is determined by the type of outlet structure. At three of the dams—Taylorsville, Huffman and Lockington—the outlets are concrete notches through the embankment. By leaving out the wier, which crosses this notch, a flume, whose capacity is flexible up to very large volumes, is obtained to pass floods during embankment construction. At the Englewood and Germantown dams the embankments are continuous across the valleys and the outlets are covered twin conduits penetrating the bottom of the fill. By building the twin conduits temporarily to about twice their final capacity considerable leeway is provided for

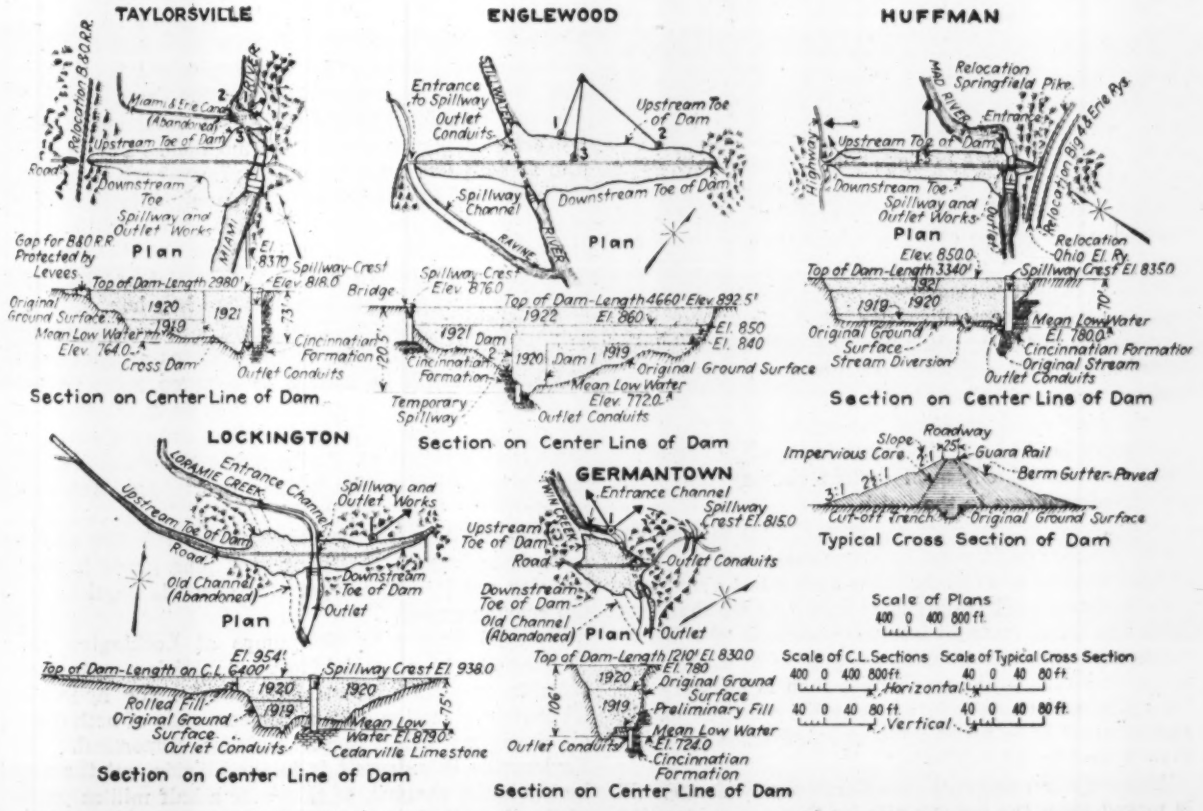


FIG. 1. PLANS AND SECTIONS OF DAMS SHOWING SEQUENCE OF FILL AND PUMPING PLANT LOCATIONS

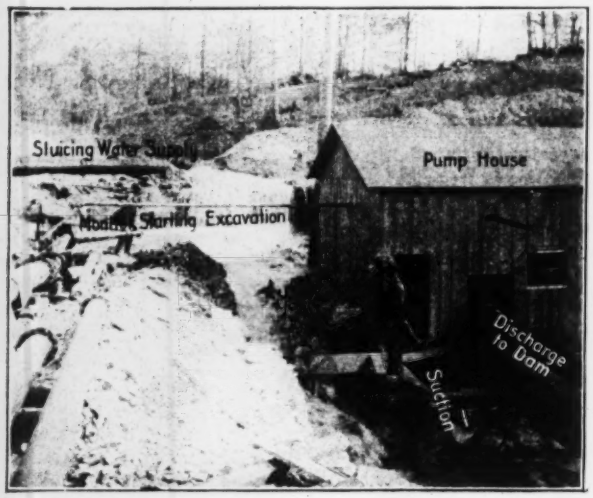


FIG. 2. START OF HYDRAULIC EXCAVATION AT TAYLORSVILLE BORROW PIT

the excess volume of flood flow, but not enough to make it safe to close all other outlets until the closure can be completed to a safe height during a working season.

At Germantown the limitations of the conduit outlet as a flood channel caused little trouble because the volume of fill required to effect closure to a safe height was not greater than could be completed in one low water season, as is indicated by the diagram of Fig. 1. At Englewood the conditions are different. Here the volume of the embankment is so great that a third season's work is required to complete it to a safe height. During the first season, as the diagram indicates, the fill leaves free both the old river channel and the outlet conduits. In the second season the river channel is closed, but a temporary spillway, in addition to the outlet conduits, is provided for the flood flow. The third season's work completes the embankment to elevation 860, which is a height safe for high water equal to that of 1913.

Aside from the diagrams little explanation of stream control and sequence of fill is necessary for the three dams having open channel outlets. Since at Huffman the outlet structure came very nearly within the original channel stream diversion was necessary. At Taylorsville the excavation for the outlet channel involved about half a million yards of earth overburden, and to dispose of this material so that channel excavation in rock could go ahead the fill west of the river was begun in 1919 and then shut down, when the ledge had been cleared off, until certain railway relocation permitted progress to the finish.

Altogether, stream control plays a vital role in determining the embankment construction processes. Only at Germantown was the condition realized of a straightaway hydraulic fill from end to end. At all the other dams the fill is made in irregular sections of embankment, with the maximum of complexity at Englewood. More numerous pipe line changes than is ordinary are therefore necessary, and considerable volumes of the embankment have to be built as cross dams by other than hydraulic fill methods.

Materials Transportation.—Earth for hydraulic fill is moved from the borrow pits by three methods: (1) train haulage from pit to sump and then pumping into the embankment; (2) sluicing from pit to sump and then pumping into embankment; (3) sluicing from the pit directly into the embankment. The first method is employed exclusively at Englewood and the second method exclusively at Lockington and at Taylorsville. At Germantown both the first and the second methods are employed and at Huffman all three methods.

Except at the Taylorsville and the Lockington operations the locations of favorable materials for hydraulic fill are in the bottoms of the valleys upstream from the dams. From these locations to the dams the average distances are about 2,000 ft. and when excavating from the far ends of the pits the maximum distances are about 4,000 ft. With the friction heads, 8 to 12 ft. in 100 ft., developed by the heavy glacial gravel, pumping in several relays would be required to move the material from the pit to the fill. It was estimated, therefore, that the cost would be less to excavate by dragline machines and haul by trains to pump sumps located adjacent to the dam sites at such elevations as permitted reasonable railway grades from the pits and as made it practicable to pump the material into embankment at any required location with a main pump and one booster pump on any pipe line. In appraising the wisdom of this decision a study of the friction heads developed in pumping the Miami glacial drift is of supreme importance. These friction heads are analyzed in a succeeding article.

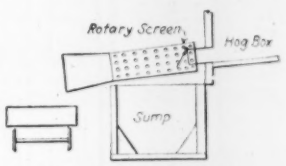


FIG. 3. DIAGRAM OF ROTARY GRIZZLY ARRANGEMENT

Upon this determination haul by train to receiving hoppers or "hog boxes" delivering to pump sumps was adopted for the Englewood, Germantown and Huffman dams. The material from the Englewood borrow pit has proved nearly perfect in gradation from coarse to fine particles for hydraulic fill dam construction and the original plan has not been modified. The borrow pits at both Germantown and Huffman have developed a scarcity of fine material. To supply this deficiency gravel and clay deposits have been opened in the hillsides flanking the ends of the dams at elevations which permit sluicing. The side hill material at Germantown is sluiced into the sump at the hog box.

At Huffman about 150,000 cu.yd. can be sluiced directly into the embankment and perhaps an additional 50,000 cu.yd. will be sluiced to a pump sump at the foot of the hill and across the valley from the hog-box sump and thence pumped into the embankment. In the direct sluicing at Huffman the pit sluice ditches lead to an inlet on the hillside overtopping the dam and from the inlet a 15-in. dredge pipe line on a trestle and thence along the beaches delivers the flow to the dam embankment. A 2½-per cent pipe grade handles the clay readily but a 4-per cent grade is required for the coarser gravel.

Material supply to the pumps at Lockington and Taylorsville is a straightforward sluicing operation. Hillside deposits of materials suitable for hydraulic fill dam construction exist at the east ends of both dams at elevations which make sluicing economical. At Taylorsville this deposit is in the hillside, cut through by the outlet channel, so that over a half million yards of the deposit sluiced accomplishes the double purpose

of removing the overburden of the rock cut for the outlet and of creating hydraulic fill embankment.

Monitor and Sluicing Practice.—To break down the streaky glacial drift for sluicing, monitor and nozzle sizes and pressures are varied. For the denser clay portions a 2½- to 3½-in. nozzle operating at 110- to 135-lb. pressure meets the conditions where the clay strata can be broken down by undercutting. It is better to shake up and fissure the deep layers by blasting. From 90- to 100-lb. pressure with a 4-in. nozzle meets best the average conditions of mixed gravel and clay. For the straight gravel containing a considerable proportion of stone too large for sluicing a stream of large volume, say 5 in. at low pressure, say 60 to 80 lb., gives the best results. Such a stream has the volume of flow required to pull away the usable materials from the oversize stone whereas a small stream at high pressure merely beats this larger stone down into a blanket which covers and protects the usable sizes from erosion. The practice is to use a No. 2 monitor for nozzles up to 2½ in. and a No. 3 or a No. 4 monitor for nozzles from 2½ to 5 in.

Different clays exhibit quite different behaviors under the action of the monitor streams. Generally the yellow and the red clays melt down completely. On the other hand, the blue clays resist dissolution. In the solid bank they stand firmly against direct attack of the stream. Where the layers are thin enough to be broken down by undercutting or when they have been fissured and crumbled by blasting the sluicing is fairly rapid. A considerable portion of the clay, however, does not melt down, but is carried by the water in lumps which, by rolling along the sluices and pipe line, are rounded into balls from the size of a marble to that of a grapefruit. These balls, of course, drop on the beaches of the fill and do not go into the cores.

Except at Huffman, where, generally speaking, only fine material is sluiced, the monitor discharge does not provide sufficient water for sluicing. The additional water is pumped to the crest of the pit face and then, led by sluices, drops over the face and flows across the pit bottom to the sump. At Lockington pumping is supplemented by gravity flow from the old Miami & Erie Canal, but broadly speaking, sluicing water at all of the conservancy dams has to be pumped. The sluices are earth ditches and 4 per cent sluice grades are found ample.

Pit development and sluice location are determined by the demand for coarse or fine materials and the locations of these materials in the pit. At Lockington, where conditions made possible the greatest regularity, perhaps, of pit development, the excavation is worked out in the shape of a fan with the pump sump at the apex. The monitor pipe line is laid on the pit bottom parallel to the face arc, with monitor connections at intervals so that any section of the face, depending upon the character of the material wanted, may be sluiced. The sluice ditches are radial. By crowding the ditches in one side with baffle boards considerable material has been added to the output by the erosion of pit tailings, and the height of working face has been increased.

Ground water at the Lockington sump stood so high that too much water was fed to the dredge pumps and the amount of solids pumped was therefore reduced. By lowering the ground water by means of a separate sump and water pump the output of the dredge pumps in per cent of solids handled was immediately increased. Overflow from the dredge pump sump is also carried over to the ground water sump. The discharge from the water pump is taken up to the sluice ditch on the hill above the pit face and added to the sluicing water.

Hauling and Hog-Box Practice.—Much of the excavation in the valley bottom borrow pits is below water level. At places the digging must also go to considerable depths to obtain the required materials. These conditions and the fact that dragline excavators were considered to satisfy best the requirements of the other excavating operations in connection with the dam construction led to the adoption of this type of machine to excavate the embankment material and to load it into cars. Ordinarily each excavator is served by two trains each consisting of five 12-cu.yd. cars hauled by a 40-ton locomotive. At periods of the work the train length has been increased by one or two cars, but normally two

FIG. 4. HOW STREAM FROM NOZZLE IS CONTROLLED

5-car trains have been plenty to handle the output of one excavator. Broadly speaking the dragline output has limited the dredge pump output. A 15-in. dredge pump has been capable of handling more material under the conditions than a dragline having 85-ft. to 100-ft. tailings, and the height of working face has been increased.

At Englewood, where the greatest volumes of materials are being handled, a steam and an electric dragline are working in the same borrow area. Both are 115-ton machines with 85-ft. booms and 4½-cu.yd. buckets. With an average pit face of 15 ft. these machines each handle comfortably from 150 to 180 cu.yd. an hour. Comparison of the two machines indicates that with current costing under 1.6c. per kilowatt-hour and with coal at $6.50 per ton on wagons at the machine the steam machine is somewhat more expensive. It is faster in operation than the electric machine, but the cost of coaling runs the unit cost higher.

At the pumps, the trainloads of material are dumped from side trestles into concrete hog-boxes. These are rectangular boxes the floors of which slope from the

trestle side and also from the ends toward a discharge outlet at the center of the opposite side. Monitors at each end sluice the material as it lies in the hog boxes to the outlets, using generally a 3-in. stream at 60-lb. pressure. Wear of the floors is about the only maintenance cost of hog-box structures. At Germantown a well built 4-in. floor of rich concrete had a life of 425,000 cu.yd. of materials sluiced. It was then practically worn out.

Screen Practice.—Material from the hog-boxes passes to the pump sumps through rotary screens which remove the oversize. These screens are the development of several experiments. At first flat or sloping grates of several types, with square openings, were tried. They had a tendency to clog under a rush of material and two or three men, working under sloppy and disagreeable conditions, were required to keep them clear. In the original installation at Germantown a traveling flat grate was found to be much better but it did not fully meet the requirements. A rotary screen with round holes was the final solution.

A typical rotary screen arrangement is indicated by Fig. 3. The screen is a sheet steel cylinder with a screening section 4 ft. in diameter and 9 ft. long. The holes are 7 in. in diameter. It is operated at about nine revolutions per minute by a 7½-hp. motor. All oversize material is rejected without hand labor except where use of the stones for construction necessitates that they be sorted out from the clay balls and any useless material contained in the screen waste. It is found that these screens also tend to rectify irregular feed from the hog-box and to deliver the solids to the pump suctions in a uniform flow. This has proved to be a very useful function, since with all reasonable care in using the sluicing monitors there will be moments when the solids will pass the hog-box outlet in masses which temporarily overload the pumps. As the discharge from the hog-box at times enters the screen end at a velocity which would shoot the solids past the screening area of the cylinder an important operating feature of each screen is a hanging flap gate which breaks the force of the outlet discharge but swings back readily to pass the water and earth.

[*Part II, in next week's issue, will present the developments in sump and pump layout and pump construction. All work is being performed by the construction department of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Charles H. Paul, assistant chief engineer, and C. H. Locher, construction manager. Much credit for the success of the hydraulicking operations is due to the division engineers at the dams. All of them have given careful thought and study to the problems encountered and have made valuable suggestions for improvements in design. They are: Arthur L. Pauls, Germantown; H. S. R. McCurdy, Englewood; Barton M. Jones, Lockington; O. N. Floyd, Taylorsville; and C. C. Chambers, Huffman. G. L. Albert, hydraulic engineer, has given special attention to the hydraulic fill installations and operations at all of the dams and S. M. Woodward, consulting engineer, has offered valuable advice and suggestions.*]

Window Display Advertises Engineering

Working paraphernalia of the engineer are displayed in the windows of the principal store of Butte, Mont., for the purpose of stimulating the interest of citizens in engineering affairs. The A. A. E. chapter arranged the display.

Activated-Sludge Experiments at Mount Vernon, N. Y.

By R. H. Eagles
Chief, Industrial Section, Sanitary Engineering Department, the Dorr Co., New York City

SIX months' operation of an experimental activated sludge plant at Mt. Vernon, N. Y., by the Dorr Co., Engineers, of New York City, has developed a modification known at "The Dorr-Peck Process." The system differs chiefly from former methods, in the application of different mechanical principles to the introduction of the air and circulation of the sludge, resulting in lower air consumption, and higher nitrogen recoveries in the sludge.

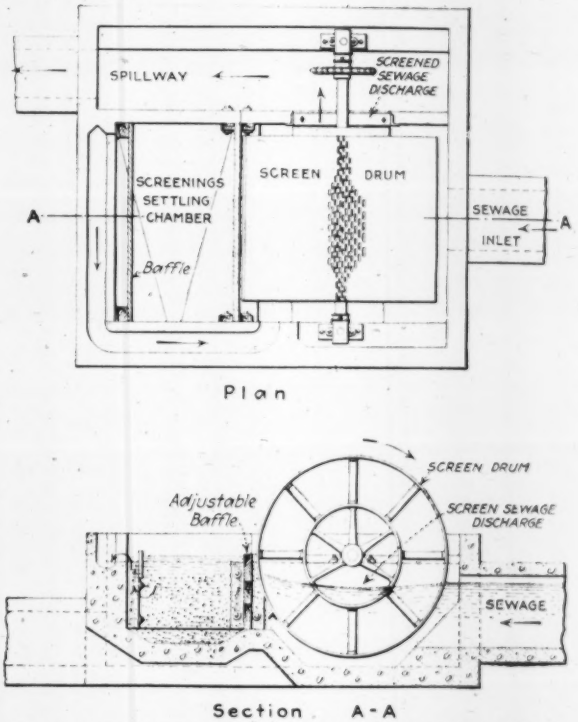


FIG. 1. PLAN AND ELEVATION OF DORRCO SCREEN

The sewage treated was fresh domestic sewage of the following average composition in parts per million: total solids, 596; suspended solids, 245; soluble solids, 351; alkalinity, 265; oxygen consuming power, 154. Detailed results for the month of November, 1919, are shown by the accompanying table. Conclusions reached are as follows:

(a) Purification is effected by 0.6 cu.ft. of air per gallon of sewage treated, with a detention period ranging from 8 to 10 hours.

(b) A clear colorless effluent is produced, containing less than 20 p.p.m. of suspended solids, up to 1 p.p.m. of nitrate and nitrite nitrogen, and is stable at least four days by the methylene blue reaction.

(c) A 90 per cent removal of bacteria is effected.

(d) The "oxygen consumed" value is reduced by 79.6 per cent.

(e) The dry sludge has a nitrogen content of 7 to 9 per cent expressed as ammonia.

(f) Sludge disposal was only slightly investigated without definite results.

The work was conducted under the supervision of C. Lee Peck, director of Research and Development of the

TEST RESULTS OBTAINED WITH ACTUATED-SLUDGE PLANT AT MT. VERNON, N. Y., NOVEMBER, 1919

Date Nov., 1919	Feed: City Plant G.P.D.	Feed: Test Plant G.P.D.	Total Solids: Raw Sew. P.P.M.	Total Solids: Effl. P.P.M.	Total Solids: Remov. %	Suspended Solids: Raw Sew. P.P.M.	Removed by Bar Screen: P.P.M.	Bar Screen: %	Dorrco Screen: P.P.M.	Dorrco Screen: %	Activating Tank: P.P.M.	Activating Tank: %	Final Effluent: P.P.M.	Final Effluent: %	Total Removed: P.P.M.	Total Removed: %
1	1,400,000	46,500	661	320	51.6	231	3	1.3	28	12.1	170	73.6	30	13.0	201	87.0
2	1,370,000	44,000	643	255	60.4	256	6	2.3	17	6.7	210	82.0	23	9.0	233	91.0
31	1,540,000	38,100	737	264	64.2	292	3	1.0	29	9.9	240	82.3	20	6.8	272	93.2
4	1,700,000	45,500	661	224	66.1	269	2	0.8	29	10.8	206	76.6	32	11.8	237	88.2
52	1,325,000	41,000	667	230	65.5	330	2	0.6	33	10.0	263	79.7	32	9.7	298	90.3
6	1,815,000	45,500	513	170	66.9	257	3	1.2	25	9.8	216	84.0	13	5.0	244	95.0
73	1,650,000	39,600	597	259	56.6	292	3	1.0	34	11.6	236	80.9	19	6.5	273	93.5
8	1,710,000	43,500	449	198	56.0	189	3	1.5	26	13.8	148	78.4	12	6.3	177	93.7
9	1,665,000	47,500	585	231	60.5	265	4	1.5	26	9.8	219	82.7	16	6.0	249	94.0
10	1,345,000	47,500	547	165	69.8	267	3	1.1	28	10.5	211	79.1	25	9.3	242	90.5
11	1,675,000	49,100	551	300	45.5	196	3	1.5	21	10.7	152	77.6	20	10.2	176	89.8
12	1,650,000	49,100	601	195	67.5	276	2	0.7	29	10.5	230	83.3	15	5.5	261	94.5
13	1,535,000	47,500	547	300	45.2	217	4	1.8	23	10.6	170	78.4	20	9.2	197	90.8
14	1,730,000	47,500	607	310	48.9	282	3	1.1	29	10.3	225	79.8	25	8.8	257	91.2
15	1,750,000	47,500	464	295	36.4	152	4	2.6	30	19.7	93	61.2	25	16.5	127	83.5
16	1,720,000	47,500	446	185	58.4	231	4	1.7	30	13.0	182	78.8	15	6.5	216	92.5
17	1,940,000	45,500	654	260	61.0	329	2	0.6	35	10.6	267	81.2	25	7.6	304	92.4
18	1,820,000	47,500	626	385	38.5	231	2	0.9	29	12.5	178	77.1	22	9.5	209	90.5
19	1,775,000	46,800	659	325	50.7	234	3	1.3	30	12.8	171	73.1	30	12.8	204	87.5
204	1,600,000	42,500	533	303	43.2	225	2	0.9	31	13.8	169	75.1	23	10.2	202	89.8
21	1,590,000	49,100	517	228	55.8	229	3	1.3	29	12.8	165	72.9	30	13.2	197	86.3
225	1,680,000	42,000	586	370	36.8	206	3	1.4	33	16.0	140	68.0	30	14.6	176	85.4
23	1,630,000	45,500	600	298	50.4	255	4	1.5	31	12.2	197	77.2	23	9.1	232	90.9
246	1,600,000	40,500	624	325	48.0	269	3	1.1	41	15.2	198	73.7	27	10.0	242	90.0
257	1,460,000	43,500	652	360	55.2	202	2	0.9	30	14.8	150	74.2	20	9.9	182	90.1
26	1,595,000	47,500	648	320	48.2	218	3	1.3	27	12.4	168	77.0	20	9.1	198	90.9
27	1,600,000	47,500	656	338	51.5	216	3	1.3	23	10.6	162	75.0	28	13.0	188	87.0
288	1,510,000	36,060	658	300	54.4	268	2	0.8	36	13.4	210	78.3	20	7.4	248	92.6
299	1,665,000	43,500	613	320	47.4	253	2	0.8	31	12.3	190	75.1	30	11.8	223	88.1
3010	1,795,000	43,500	578	299	48.2	203	3	1.4	35	17.2	144	70.9	21	10.4	185	91.1
Av....	1,628,000	44,902	596	277.7	53.6	244.6	2.9	1.24	29.3	12.2	189.3	76.9	23	9.6	221.7	90.4

Date Nov., 1919	Dissolved Solids: Raw Sew. P.P.M.	Dissolved Solids: Effl. P.P.M.	Dissolved Solids: Remov. %	Oxygen Consumed: Raw Sew. P.P.M.	Oxygen Consumed: Screened — Influent P.P.M.	Oxygen Consumed: Screened — Influent %	Oxygen Consumed: Effl. P.P.M.	Oxygen Consumed: Remov. %	Relative Putrescibility: Raw Sew. Dil.	Relative Putrescibility: Ser. Inf. Dil.	Relative Putrescibility: Eff. Dil.	Air: Per 24 Hr., Cu. Ft.	Air: Cu. Ft. per Gal.	Alkalinity (CaCO3): Raw Sew. P.P.M.	Alkalinity (CaCO3): Eff. P.P.M.	Weather
1	430	290	32.8	116	119	—2.5	23	80.5	1:10	1:10	1:00	31,400	0.67	260	195	Rain
2	387	232	40.0	139	149	—6.9	26	82.6	1:10	1:10	1:00	25,670	0.59	252	162	Fair
31	445	244	45.2	211	212	—0.5	35	83.5	1:20	1:20	1:00	30,180	0.79	300	195	Fair
4	392	192	51.1	157	162	—3.1	35	78.4	1:10	1:10	1:10	30,750	0.68	287	195	Fair
52	337	198	41.4	161	154	4.3	26	83.2	1:10	1:10	1:00	28,050	0.68	265	150	Fair
6	256	157	38.7	123	119	3.3	28	76.4	1:10	1:5	1:00	29,230	0.65	275	165	Fair
78	305	240	21.3	123	129	—4.6	31	76.0	1:10	1:10	1:00	31,020	0.78	260	180	Fair
8	260	186	28.5	136	137	—0.7	35	74.5	1:20	1:20	1:00	28,940	0.66	242	182	Fair
9	320	215	32.8	141	141	0.0	30	77.8	1:20	1:20	1:00	31,310	0.66	217	170	Fair
10	280	140	50.0	203	204	0.5	32	84.3	1:30	1:20	1:00	30,150	0.63	295	185	Fair
11	355	280	21.1	163	161	1.2	34	66.5	1:20	1:20	1:00	30,120	0.61	250	185	Fair
12	325	180	43.0	125	124	0.8	35	71.7	1:10	1:10	1:00	30,305	0.62	290	190	Rain
13	330	280	15.2	119	117	1.7	30	74.1	1:10	1:10	1:00	32,385	0.68	230	170	Rain
14	325	285	12.3	129	124	3.9	24	77.5	1:20	1:20	1:00	30,865	0.65	260	175	Fair
15	312	270	13.4	146	144	1.3	33	77.1	1:20	1:20	1:00	30,125	0.64	232	175	Fair
16	215	170	20.9	150	145	3.3	31	78.6	1:20	1:20	1:00	29,295	0.62	227	165	Fair
17	325	235	27.7	181	182	—0.5	33	81.9	1:20	1:20	1:00	29,930	0.66	252	182	Fair
18	395	363	8.1	173	165	4.6	32	80.6	1:20	1:20	1:00	30,915	0.65	285	180	Fair
19	425	295	30.6	145	140	3.4	35	75.1	1:20	1:20	1:00	29,140	0.63	295	190	Fair
204	308	280	9.1	140	138	1.4	34	75.5	1:20	1:20	1:00	29,910	0.70	280	185	Fair
21	290	198	31.7	125	119	4.8	31	74.0	1:20	1:20	1:00	28,745	0.59	247	185	Fair
225	380	340	10.4	168	155	7.7	39	75.0	1:20	1:20	1:00	27,020	0.64	240	180	Fair
23	345	275	20.3	158	149	5.7	27	81.9	1:20	1:20	2:1	29,440	0.65	280	190	Fair
246	355	298	16.0	187	185	1.0	33	82.2	1:20	1:20	1:00	29,145	0.72	310	200	Fair
257	450	340	24.4	208	207	0.5	29	86.0	1:20	1:20	1:00	27,825	0.64	295	190	Fair
26	430	300	30.2	148	147	0.9	35	76.3	1:20	1:20	1:00	29,980	0.63	290	185	Rain
27	440	310	29.5	162	160	1.2	29	82.1	1:20	1:20	1:00	31,020	0.65	250	180	Fair
288	390	280	28.2	160	159	0.6	29	81.8	1:20	1:20	1:00	29,130	0.80	302	180	Fair
299	360	290	19.4	162	159	1.8	34	79.0	1:20	1:20	1:00	29,710	0.68	245	180	Rain
3010	375	278	25.9	159	158	0.6	32	79.8	1:20	1:20	1:00	30,000	0.69	250	180	Fine
Av....	351.4	254.7	27.3	153.9	152.1	1.16	31.3	78.5	1:17.6	1:17.2	1:03.0	29,723.5	0.66	265.4	181	

1 Feed off 2 hr. to fill No. 3 with raw sewage for experiment.
2 Shut down 4 hr. running tests for hp. consumption.
3 Shut down 4-hr. repairing belt to screen and repairing pulley (slipping on shaft).
4 3-hr. down—replacing belts.
5 Down total of 2 hr. for fuse trouble.
6 Shut down for power 2 hr.
7 Shut down for power 1 hr.
8 Shut down 5 hr. city plant, cleaning bar screens and tests on compressor.
9 Shut down 2 hr. (repairs to air meter).
10 Air meter not recording.

Sanitary Engineering Department of The Dorr Co., assisted by F. H. Rhodes and S. L. Neave, chemists. Analytical results and biologic effects were checked up by Prof. D. D. Jackson and Robert Brown of Columbia University.

The experimental plant was established at the sewage-works of Mt. Vernon, N. Y., by permission of the Board of Aldermen of that city. The feed to the experimental plant was cut from the main sewage flow after passing through a bar screen with ¾-in. intervals. The average flow treated was 45,000 gal. per day of rather strong domestic sewage, and the treatment units consisted of fine screening by the Dorrco screen, followed by two combination aeration-sedimentation tanks in series, each 12 ft. in diameter by 11 ft. deep, with a total capacity of 17,600 gallons.

The first unit in the system is the Dorrco screen (Fig. 1), which is a self-cleaning revolving drum screen. It removes the tough and non-digestible solids, while the soft and easily digested solids are passed through to the activating units. Low nitrogen solids are thus excluded with a corresponding increase in the grade of activated sludge.

The two deep tanks (Fig. 2) are constructed to effect aeration, sludge circulation, and sedimentation in each individual unit. Each tank is divided into two com-

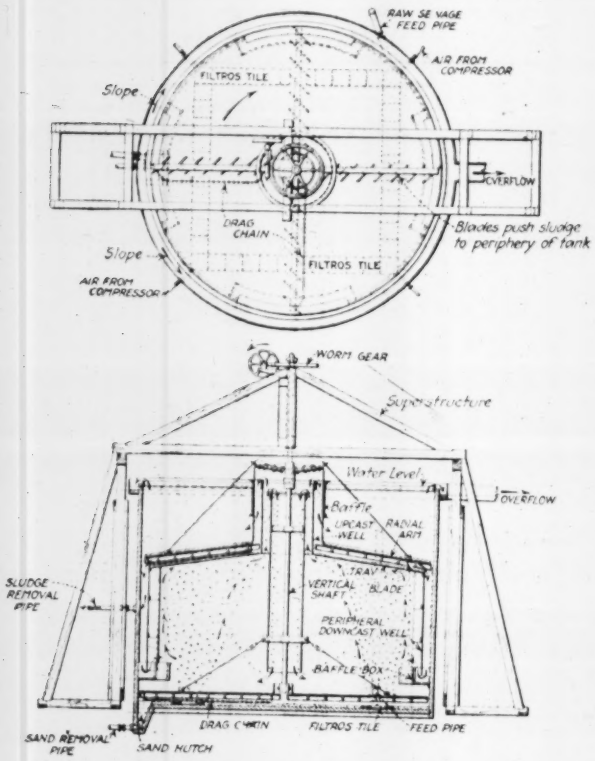


FIG. 2. AERATION—SEDIMENTATION UNIT OF DORR-PECK ACTIVATED-SLUDGE PROCESS

partments by a horizontal tray. Aeration occurs in the lower compartment, sedimentation in the upper. The depth of liquor in the aeration chamber is 6½ ft. The diffusion medium is filtros tile laid in the bottom of each tank. A central vertical shaft is suspended in each tank, to the bottom of which are attached two radial arms with squeegees which engage and keep clean the exposed surface of the filtros tile, and at the same time move the settled sludge to the periphery. Half way up on the shaft and engaging the upper surface of the horizontal tray or diaphragm (which is the floor of the sedimentation chamber), are attached similar radial arms with plows which move the settled sludge out to the periphery and allow it to drop back through peripheral downcast wells into the aerating chamber. Thus a circulation of the sludge is effected and a concentration of fresh sludge is kept in the aerating chamber. Provision is made for drawing off sludge from the final sedimentation chamber to prevent its building up and escaping with the overflow. A clear overflow is continuously removed by a peripheral launder around the top of the tank.

Approximately 75 per cent of the air is introduced into the first unit and 25 per cent into the second.

An important feature of the mechanical design is that it utilizes the natural lifting effect of the air, by constructing its exit, in such a manner that a rapid continuous circulation of the activated sludge and incoming sewage feed is effected. This gives intimate and prolonged contact between the air, biologic floes, and sewage, with the resulting air economy.

The air was supplied by a Nash hydro-turbine compressor, delivering the air at an average pressure of 4¾ lb. per square inch and was measured by the Rotary Meter Co.'s compensating meter, which is so constructed as to compensate for any pressure passing through it, registering the actual amount of free air passed. The sewage flow was recorded over a 90 deg. V-notch weir by a Foxboro recording depth gage. Both meters were carefully checked up. The power requirement of the two aerating unit mechanisms amounted to one-half horsepower.

Snow and Water Relations in Nevada

WATER storage represented by the snow on the Sierra Nevada in April, 1920, was below normal, averaging 77.5 per cent of normal in the Yuba Basin, 76 in the Tahoe basin, 80 in the Carson basin and 84.8 per cent in the Walker basin. The probable run-off from these basins during the 1920 season, was estimated provisionally in April at corresponding percentages of the normal annual run-off, but this estimate was reduced to 10 to 25 per cent in May for precautionary reasons. Observations in the Humbolt basin have not been established long enough to determine normal conditions, but although the amount of snow on the ground averaged only 76 per cent of that in 1919 the run-off for 1920 was expected to approach that of 1919 owing to probable improvement in spring and summer precipitation. These results of a study of snow surveys are given by J. E. Church, Jr., in charge of the Nevada co-operative snow surveys at Mount Rose Observatory, Reno.

The run-off from two basins in 1919 is shown in the accompanying table. The high figures for April and May and the practical exhaustion of the snow cover by June, as shown by this table, was due to the relatively high temperature of April and May. For 1920, a temperature deficiency in April and moderate temperature in May were expected to reverse the former conditions and to assure at least a moderate run-off in June and July. Further, although the snow cover this year was less deep than in 1919, the precipitation in April, 1920, assured a run-off nearly equal to that of the previous year.

A fairly definite forecast of the late summer run-off for the Tahoe and Truckee basins is made practicable because the run-off of Lake Tahoe is controlled artificially. From the records of lake level and draft for irrigation it is estimated that the available supply above the outlet level will be exhausted early in September, or late in September with a reduced draft for irrigation. This impending shortage is accentuated somewhat by a rise in the bar at the outlet of the lake. Normally, the lake level should be raised by rains in October to December, but for several years the level has continued to fall during October and November. The chances are about even for a rise in the lake in December, 1920, but only unusual rains can improve the situation before that time. Navigation has been interferred with, some boat stops having been discontinued owing to shallowness of the water.

This shortage of water at Lake Tahoe is due largely to lack of normal rains in spring and summer. In the spring of 1918, 1919 and 1920 the snow cover in the Tahoe basin was 95, 103 and 76.2 per cent of normal. Heavy rains in early April, this year, were offset partially by excessive evaporation and the relatively greater drain upon a shallow snow cover to prime the soil. These summer losses have reduced the

run-off efficiency of the years mentioned to 53.6, 60.9 and 46.2 per cent respectively. On the theory of probabilities the forecast is for a wet spring and summer rather than a heavy winter in the coming season of 1920-21.

RUN-OFF FROM SNOW FIELDS OF THE SIERRA NEVADA IN 1919 (PER CENT OF NORMAL)

	Tahoe Basin, per Cent	Carson Basin, per Cent
Snow cover, April	103 0	96 8
Run-off April	100 0	86 4
Run-off May	121 5	115 2
Run-off June	7 7	27 6
Run-off July	0 0	4 0
Run-off April-July	72 9	66 6

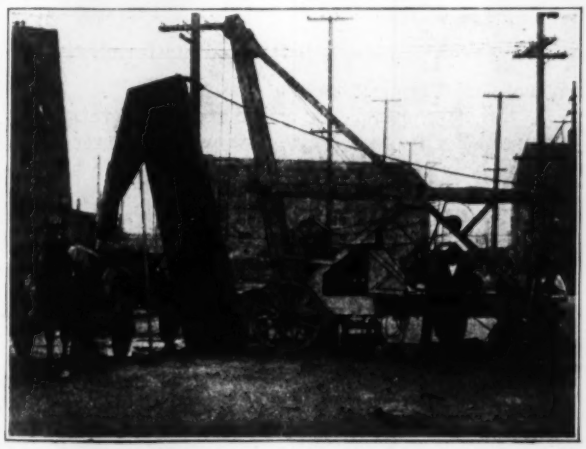
This snow survey and water forecast system, which originated in Nevada, was described in *Engineering News-Record*, Oct. 23, 1919, p. 766. It is now being operated jointly by Nevada and California under the direction of Prof. J. E. Church, Jr., of the University of Nevada, and Major Paul M. Norboe, chief assistant state engineer of California, as noted in *Engineering News-Record*, Jan. 1, 1920, p. 60.

Portable Elevator Cleans Sand Catcher at San Francisco

A PORTABLE elevator which has been built by the city of San Francisco for the purpose of removing material from the sand catcher of the Treat Avenue sewer does the work with less labor, in less time and at lower cost than was found possible by the old method of bucket and windlass.

The detritus chamber for which the elevator was primarily designed is a part of a main trunk combined sewer. The chamber is 10½ x 12½ ft. in section and about 1400 ft. long. It has a center partition 4 ft. high for its full length and during storm periods the deposit accumulates throughout the entire length of the chamber to about the height of the center partition.

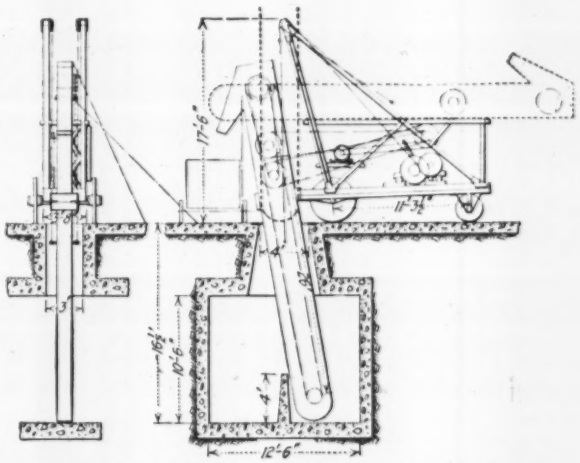
After the seasonal storms are over the flow is diverted to one side of the sedimentation chamber by means of a dam at the inlet. Through a manhole the elevator is then lowered so as to excavate from the other side of the center partition and men with wheelbarrows are sent down to move the material into a pile where the elevator can handle it. Designs for a longitudinal conveyor to replace the wheelbarrow men are now under consideration and with this improvement it is expected that the daily capacity of the elevator will be doubled.



PORTABLE BUCKET ELEVATOR FOR SEWER CLEANING

Under the old system of elevating the material with bucket and hand windlass, an average of about 4 cu.yd. per day was the best that could be done. With the elevator and five or six wheelbarrow men working in the sewer the quantity handled is at least 28 cu.yd. per day. The elevator is designed to handle 6 cu.yd. per hour when worked continuously at full capacity.

As shown in the drawing, the elevator proper is designed to be supported by cables attached at the center of gravity so that when raised to the top of its support by means of a hand winch its bottom swings clear of



DETAILS OF PORTABLE BUCKET ELEVATOR FOR CLEANING SEWER SAND CATCHER AT SAN FRANCISCO

the street and it can be easily tipped over in a horizontal position and placed on top of the truck for moving. In order to steady the elevator in position while in operation it is attached to the front end of the truck by means of wooden blocks and steel bolts and swinging or vibration at the top is reduced by means of a pair of braces resembling pike poles.

Power is supplied by a 5-hp. motor, current for which is taken from special wires strung on the poles of a convenient power line. The upper part of the elevator proper is housed in a sheet metal casing so as to prevent the spilling of any material on the street where the work is in operation. The buckets are made of malleable iron and are mounted on chain belts. The outfit, as shown, exclusive of the bucket elevator proper, was built after the design prepared by the city at a cost of about $2300.

Fuller's Earth Output

About 106,000 short tons of fuller's earth, valued at $2,000,000, or $18.87 a ton, was produced in the United States in 1919, as shown by preliminary returns made by the producers to the U. S. Geological Survey, Department of the Interior. These figures are the highest yet recorded by the Geological Survey, and show an increase of 217 per cent in quantity, and of 563 per cent in value, in 10 years. The increase in quantity in 1919 compared with 1918 was 25 per cent and the increase in value was 74 per cent. The average price per ton increased from $13.57 in 1918 to $18.87 in 1917. Florida, which has long been the leading producer, made nearly nine-tenths of the output in 1919.

Doubly Eccentric Load Pressure on Rectangular Footings

By Marshall G. Findley
Assistant Designing Engineer, Board of Commissioners of the Port of New Orleans, New Orleans, La.

COMPUTATION of the varying pressure on a rectangular base due to the reaction of a homogenous elastic foundation material to load eccentric in one direction only is fairly simple. In general, the formula $p = \frac{P}{A}(1 \pm 6e)$ is correct for the extremes of unit pressure, in which e is the eccentricity expressed as a decimal portion of the length P, the total vertical load, and A the cross section of the base. If, however,

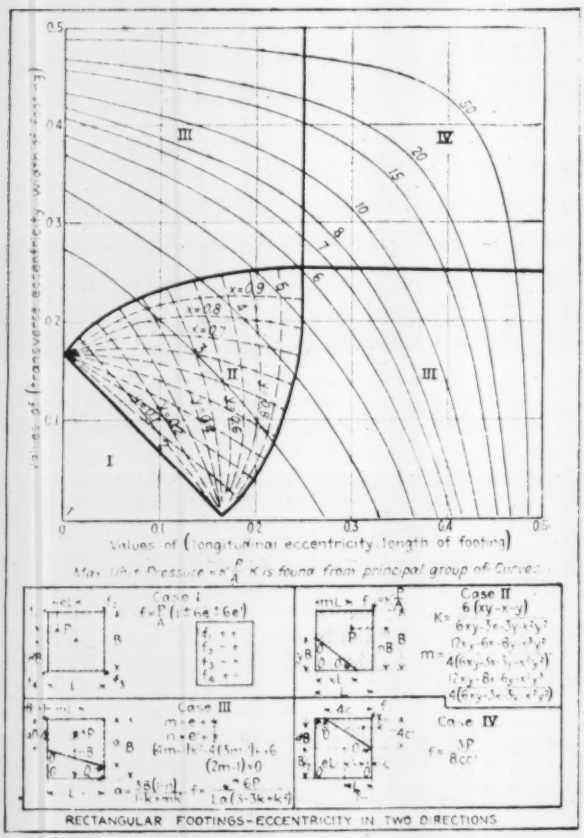
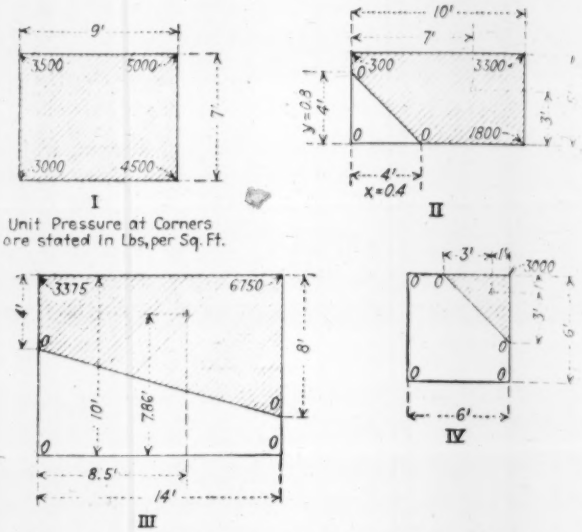


FIG. 1. DIAGRAM FOR COMPUTING PRESSURES ON DOUBLY ECCENTRIC FOOTINGS

the eccentricity is rather large and the material cannot take tension, one should use instead the formula $p = \frac{P}{A}\frac{4}{3(1-2e)}$. In using this formula, p applies only to the maximum unit pressure along the edge nearest the load, and the value of e must be greater than $\frac{1}{3}$ and less than $\frac{1}{2}$.

When there is double eccentricity, such as for instance that caused by traction to the north and wind blowing to the east, the case becomes much more difficult. Checking a number of methods in current use disclosed the fact that not only did they give results inconsistent with each other, but also that their results could be proved in many cases far from correct. A study of the case, which reduces at once to a problem in pure mathematics, disclosed the fact that there are four cases, each having an entirely different set of formulas. Two of these sets are simple, one more complex, and a fourth capable of direct solution only by determinants, and the solution awkward to handle. To meet the difficulty, the accompanying diagram was developed.

As a rule, in designing the only foundation figure



Unshaded portions of diagrams denote portion of base lifted from contact with foundation material.

FIG. 2. TYPICAL EXAMPLES OF FOUR CASES OF DOUBLE ECCENTRIC LOADING

desired is the maximum unit pressure. To find this from the diagrams, (1) compute the value of $\frac{P}{A}$, the average unit pressure; (2) compute the values of e, the longitudinal ratio of eccentricity, and e', the transverse ratio of eccentricity from the given side pressures and loads; (3) plot on the diagram, which represents one quarter of the base, an abscissa e and an ordinate e'; (4) read from the principal curves the value of K; (5) multiply $\frac{P}{A}$ by K, which gives the maximum unit pressure on the one.

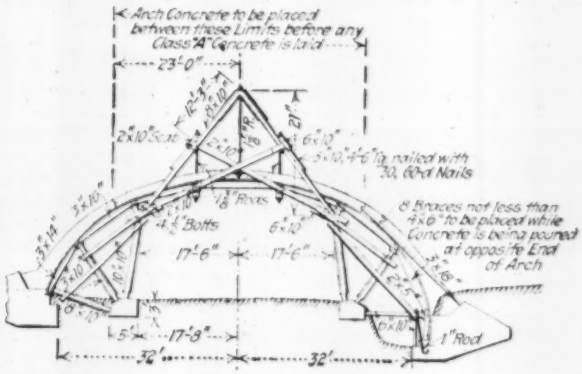
For figuring moments in a cantilever footing, this full value of the maximum corner unit reaction is too high to use as uniformly distributed, and the exact distribution of load makes rather complex figures; a value of $\frac{1-3K}{4} \times \frac{P}{A}$ distributed uniformly is convenient and conservative.

In the rare event that more exact information is required, the formulas given below the curves afford a solution for Cases I, III and IV. To solve Case II, for which the formulas are awkward, values of the ratios x and y are plotted on the diagram, and from these any other desired information may be obtained, by application of the elementary principles of solid geometry. The other two cases are fairly simple mathematics.

It should be noted that the assumptions are: (1) that the foundation material cannot take tension; (2) that it follows Hooke's law in compression, and (3) that e and e' are less than 0.5. In case either e or e' is greater than 0.5 it becomes necessary to provide for tension.

Case	Data Given: P (Lb.)	M Ft.-Lb.	M'Ft.-Lb.	L (Ft.)	B (Ft)	Computed: e	e'	P/A	From Diagram: K	Computed Max. Pres. (lb. per sq. ft.)
I	252,000	70,875	18,375	9	7	0.031	0.010	4,000	1.25	5,000
II	55,000	110,000	27,500	10	5	0.2	0.1	1,100	3.0	3,300
III	220,500	330,750	630,630	14	10	0.107	0.286	1,575	4.29	6,750
IV	8,000	16,000	16,000	6	6	0.333	0.333	222	13.5	3,000

To illustrate typical solutions the accompanying tabulation of four cases is given, the maximum unit pressure being worked out in each case from the simple formula. In Fig. 2 the more precise analysis of each case is shown as worked out by the formulas at the bottom of Fig. 1. It should be noted that the values of K as worked out in the formulas in Fig. 1 are not necessarily the same as the K for the same case as worked out by the diagram.



ELEVATION OF SPECIAL TRUSS TO SUPPORT CONCRETE ARCH BRIDGE

Overhead Truss Supports Falsework for Concrete Arch

Need for Clearance for Street Railway Leads to Use of Timber Framework Penetrating Solid Arch Rib

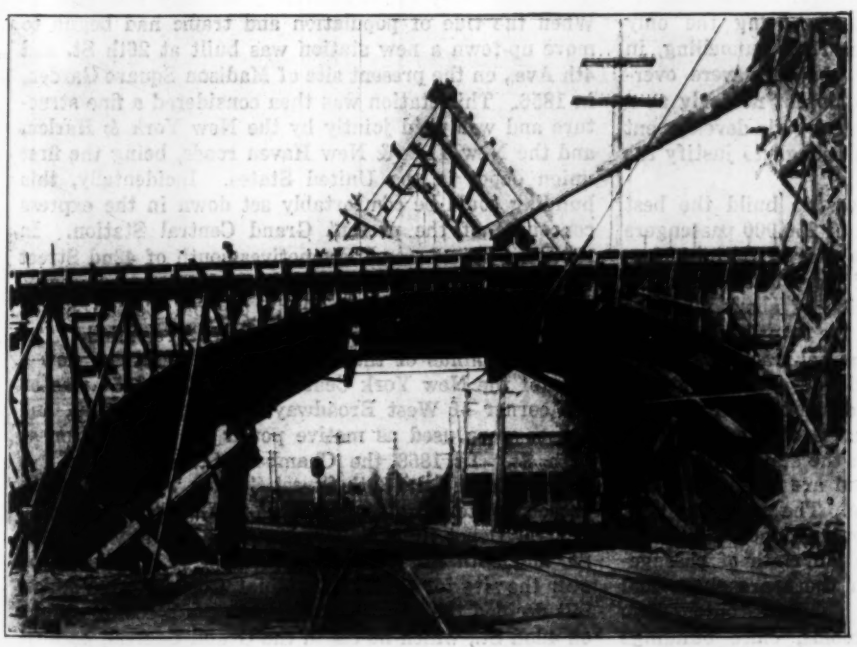
By R. W. Stewart
Chief Deputy City Engineer, Los Angeles, Cal.

On account of the wide clearance required for an interurban electric railway under the new Arlington Heights bridge at Los Angeles, Cal., it was decided to support the falsework for the arch ribs on a series of so-called scissors trusses extending up from the ground near the springing line through the arch rib proper. Openings were left where the truss timbers pass through the rib and were filled after the main arch was poured and the falsework removed.

The arch has a clear span of 64 ft., but it was permissible to erect verticals at a distance of about 18 ft. from the center line and leave room for the car line. Small concrete pedestals, therefore, were placed here and the main posts of the triangular trusses erected on them. There were four trusses spaced about 6 ft. apart carrying transverse beams on which the segments for the lagging were placed.

It will be noted that the falsework would not resist the longitudinal stress along the arch if one haunch was poured while the remainder of the falsework was without load. It was, therefore, decided to pour the crown section first, as indicated on the drawing, and after it had set the concrete so poured was braced at one end by struts to hold it while the haunch at the other end was poured. After the first haunch was poured and had set the anchorage of the reinforcing rods which pass through crown and haunch and into the abutments formed a tie which permitted the removal of the struts.

In pouring the crown section settlement due to deflection of the trusses and other causes amounted to 1¼ in. and the crown drifted about 1 in. toward one abutment, the joists at the first panel from the center toward the abutment rising off the cap. The gap between these joists and their supports was filled with thin boards and that haunch filled, causing the crown to drift back to its original position. The last operation was pouring the opposite haunch. When both haunches were poured the central part of the arch settled an additional ⅜ in. The allowance for anticipated settlement varied from ½ to 2 in., so that the arch after completion was close to its correct position. The bottom chords of the trusses carry 40,000-lb. tension. They are built up of five pieces of 2 x 10-in. plank, three of which pass through the center joint on one leg and two through on the other leg, the other pieces being cut on each side of the joint. This 40,000-lb. tension was transmitted entirely by nails driven through the layers of plank which projected above the center joint. The correct number of nails was determined by reference to the tables by H. C. Dewell published in *Engineering News-Record*, Dec. 27, 1917, p. 1,211.



OVERHEAD TRUSS CENTERING PERMITS CLEAR PASSAGEWAY

Grand Central Development Seen As Great Civic Center

New York Passenger Terminal and Adjacent Property Surpassing Expectations as Unit Including Depot, Post Office, Hotels, Office Buildings, Apartments, Clubs and Stores — Use of "Air Rights" Above Tracks — Service and Power Units

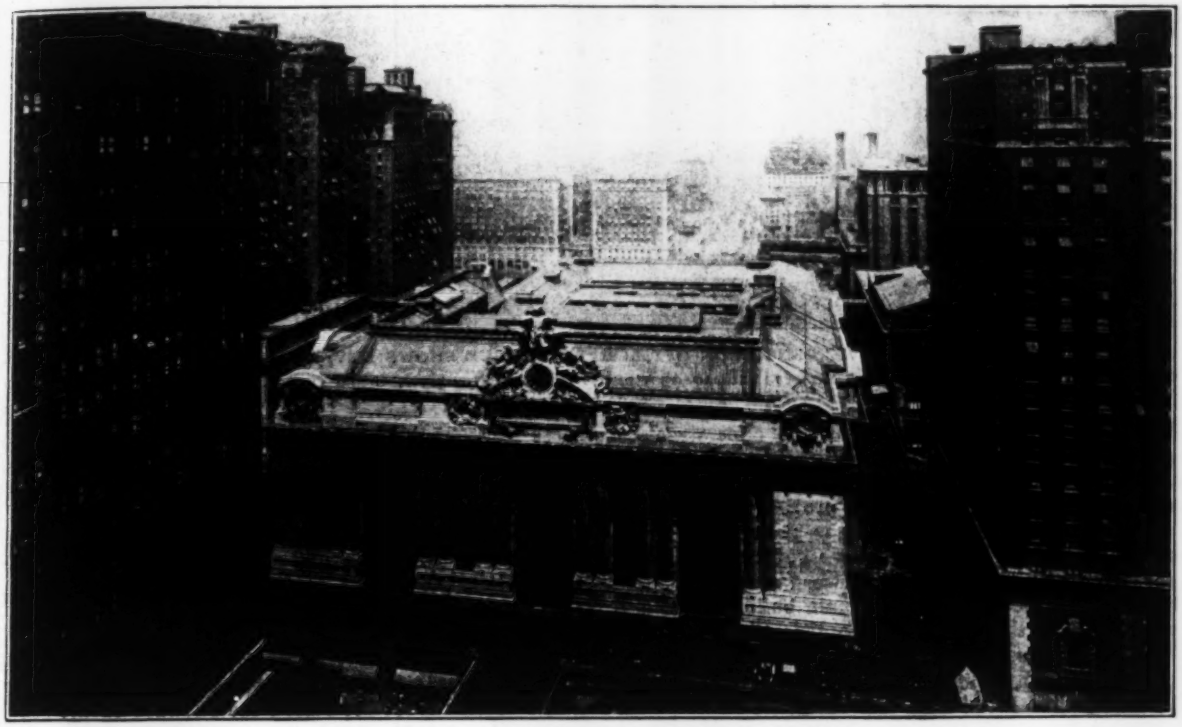
ANNOUNCEMENTS recently made of projected development of the Grand Central property in New York City call attention to the fact that the building of the great passenger terminal of the New York Central and the New Haven railroads has already led to the creation of a remarkable civic center far surpassing the original plans in size and importance to the city, and to the railroads that enter the terminal. In addition to the building of the depot, post office, hotels, office buildings, apartments, clubs, stores and the opening of important city thoroughfares, which has already been accomplished through the foresight of engineers and other railroad officers in the development of the "air rights" over the terminal trackage following the electrification, construction has now commenced on additional apartment houses and a large extension of the railroad offices, and there is actively projected the building of a thirty-one story office building, with over 1,000,000 sq.ft. of office space, at a rental of $4,700,000, all over the depressed tracks on sites on which it was not thought that building height would exceed six stories. While the New York passenger terminal of the Pennsylvania Railroad is unique in being the only project of its kind which involves river tunnelling, in which seemingly insurmountable obstacles were overcome, the Grand Central now stands out not only as a great railroad terminal but as a great civic development with an earning power more than enough to justify the very large expenditure.

While the primary purpose was to build the best terminal possible, with a capacity of 250,000 passengers per day, the foresight of those in charge of the undertaking has led to the opening of more than two miles of city streets and the reclamation of about 40 acres for building purposes—all over the two levels of the thirty-two miles of electrified terminal tracks—forming an impressive and beautiful civic development where there existed before a steam- and smoke-filled railroad yard crossed only by foot bridges. Groups of buildings to which access may be had from the station concourse itself without going above ground are remarkable for their diversity of service and use. The main building, with the express and suburban levels connected by long ramps instead of stairways, is a labyrinth of passageways—"inside streets" on which there are shops and stores—connecting with three subway routes, two hotels with more than 3,000 rooms, office buildings housing some 6,000 workers, a post office, restaurants and two university clubs. Even to those who constantly use the terminal but little is known of the hidden network of power and service facilities, the machinery and power plants—one of them excavated out of solid rock 90 ft. below the level of the street—that make possible the operation and the maintenance of the whole group. To any one not well acquainted with New York City it would be difficult indeed to convey an impression of what the building of the Grand Central has involved without a sketch of the historical approach that led to these vast plans being initiated by the New York Central Railroad in 1903, with the actual opening of the new station in 1913.

Since the opening of the great passenger station in New York City in 1913, the development of the Grand Central property has in many respects far surpassed original expectations. With its hotels, office buildings, apartments and underground streets, it not only is a wonderful railroad terminal but also a great civic center. Recent announcements of projected development for utilization of the "air rights" over the yard tracks, on a scale for which there is no precedent, may well serve as the occasion for retelling at least a part of an old story and recording more recent developments together with facts which appear to be little known. This account was prepared in the thought that it would be of more than passing interest to engineers as illustrating an unexampled civic development resulting from a great engineering undertaking.—Editor.

What was probably the first real railroad passenger terminal in New York City was leased in 1839 by the New York & Harlem Railroad, now a leased line of the New York Central, at the corner of Centre St. and Tryon Row, on the site of the southern portion of the present Municipal Building, some three miles further down town than the present Grand Central. About eleven years later the old building was taken down and a five story depot and office building was erected. When the tide of population and traffic had begun to move up-town a new station was built at 26th St. and 4th Ave., on the present site of Madison Square Garden, in 1856. This station was then considered a fine structure and was used jointly by the New York & Harlem and the New York & New Haven roads, being the first union depot in the United States. Incidentally, this building could be comfortably set down in the express concourse of the present Grand Central Station. In 1857, the use of steam locomotives south of 42nd Street was discontinued; so freight cars and passenger coaches were drawn by horses both to the old Centre Street Station and to the Twenty-Sixth Street Terminal.

The terminus of the Hudson River Railroad, now a part of the New York Central System, in 1851 was on the corner of West Broadway and Chambers St., and horses were used as motive power up to a station at 30th St. In 1868 the Chambers Street Station was abandoned and the 30th Street Station was used as the passenger terminal until the opening of the Grand Central Depot in 1871. Traffic soon outgrew the 26th St. and 30th St. Stations, and after great discussion over the site for the new terminal, Commodore Vanderbilt decided the question by selecting a piece of ground on 42nd St., which he called the Grand Central, because



PRESENT DEVELOPMENT FROM TOP OF BUILDING AT 41ST STREET LOOKING NORTH UP PARK AVENUE

Hotel Belmont in left foreground beyond which are Biltmore Hotel (surmounting incoming station), Yale and Princeton clubs, Vanderbilt Concourse offices, with Paterno Apartments in background. Commodore Hotel at right, with railroad and post office building, Grand Central Palace and 50th St. power plant beyond. There are direct underground connections between main building and Biltmore Hotel, Yale and Princeton clubs, Vanderbilt Concourse offices and Commodore Hotel.

of its accessibility. Used by the three railroads, the Grand Central Depot was enlarged by the construction of an annex between 1884 and 1886, and in 1900 the station was again enlarged, this time to accommodate about 60,000 passengers daily. The number of tracks was increased and three stories were added to the main building.

Particularly with the tremendous growth in suburban traffic it soon became evident that the facilities of the old Grand Central Depot could not be expanded to meet future traffic demands without building an entirely new terminal on a much larger scale. Sentiment was developing for the electrification of the roads using this station and in January, 1902, the case was crystallized by a serious accident which occurred in the Park Ave. tunnel between 96th St. and 56th St., connecting with the elevated structure northward where the road crosses the Harlem River from Manhattan Island. As a result the New York Legislature passed an act requiring the railroads, after a certain date to operate their trains by electricity through Park Ave. and attention was given to the plan of reconstructing the terminal. In 1903 plans were begun for the present development.

With the requirement to electrify and with the necessity of providing tremendously larger facilities to handle the traffic of future years came the idea of the present development: a two-level yard and the reclamation of all the space over the tracks. Actual construction was begun in the Autumn of 1903 with the widening of the yard entrance at 50th St., before excavation was begun to establish a lower level. To carry out the construction under traffic and change the entire plant so that not a vestige of the old remained, to keep 800 trains (including work trains) running per day, with a traffic of from 75,000 to 100,000 passengers, required the closest co-ordination between operating and engineering departments in the division of space for construction and operation. For this purpose and to provide for the larger terminal facilities the first thing required was more room, and large purchases of land were made adjoining Lexington, Park and Madison Aves., increasing the terminal area from 23 acres to 79 acres, including both levels of tracks. Articles on the original construction appeared in *Engineering Record* of February 8, 1913, page 144, and in *Engineering News* of May 1, 1913, page 883. The story already has been told how this construction, involving the excavation of 3,250,000 cu.yd. of material (about 2,000,000 cu.yd. of which was solid rock), over 50,000 tons of structural steel and about 1,000,000 barrels of cement, was carried out without interruption to service rendered the thousands of passengers who used the terminal daily while the old structure was being taken down and replaced with the new terminal.

With the opening of the new station in 1913, there already had been built over the yard tracks Grand Central Palace, and the Post Office and office building. In 1914 the Biltmore Hotel and the incoming station, which it surmounts, were completed. The main power plant at 50th St., including heating and electric substation units, to serve all of the buildings of the group, had been completed and put into operation previous to the opening of the main building. Between 1916 and 1918 the apartment buildings over the tracks between 47th and 48th Sts. and 50th and 53rd Sts., were com-

PRESENT GRAND CENTRAL CIVIC CENTER ON UPPER PARK AVENUE SHOWS DEVELOPMENT OF "AIR RIGHTS"

Looking down Park Avenue from 48th Street: Paterno Apartments in right foreground, Grand Central Palace at left. Commodore Hotel between Palace and Head building, beyond which is Hotel Belmont and Biltmore Hotel, partly hidden by apartment buildings.

pleted, following the building of the superstructure carrying the city streets across the yards. The Commodore Hotel, connecting directly with the main station building, was opened in 1919. To provide the additional heating capacity necessary a power plant 90 ft. below the street level at 43rd St. had been built. During this year the viaduct connection between Park Ave. and the south approach around the main building was also completed. In the meantime the Yale Club, the Vanderbilt Concourse Offices, and the Hotel Chatham had been erected.

Although the terminal—in its larger sense—is even now incomplete, with the vacant rectangles still existing over the yards, it has already passed expectations in some respects. Most striking is the height and diversity of the buildings which have been erected and are planned, as indicated by the project to build the Park-Madison Building, 31 tories in height, on the two rectangles bounded by Madison and Park Aves., 46th and 47th Sts., and a 25-story building on the two plots immediately southward. The uses to which these structures are put seem to represent almost every form of business and activity to be found in a great city. The development as a whole has already become so large that the tax revenues accruing to the City of New York from the Grand Central property have increased from about $700,000 to almost $3,000,000. While the utilization of "air rights" over the terminal yards appears to be the most important phase of the present work to those in charge of the property, the traveller is more particularly struck by the many services rendered him and the places and buildings that can be directly reached from the main building.

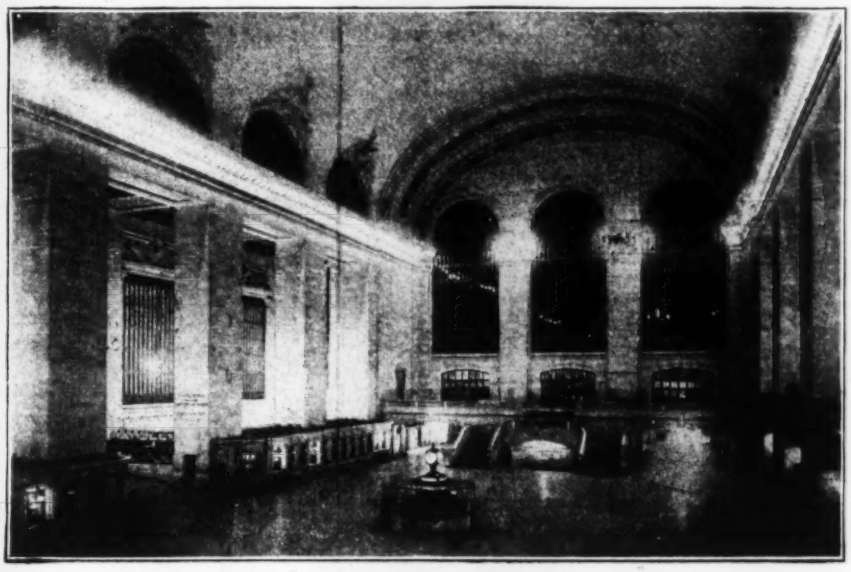
It is not exactly accurate to refer to the main building with its two levels and many passages as a labyrinth, since the station was so carefully laid out that the movement of the traveller is a progressive one in which different levels are reached by ramps of easy grade with the ready guidance of legends—which were placed after a most careful study—whether the passenger enters from the street, the subways or the connecting hotels or offices. On entering the main concourse one is instantly impressed with the great size of the room and even the sophisticated commuter must sometimes marvel at the pains expended in working out the architectural detail. The walls and columns, finished in Botticine marble and Caen stone, with arched windows 75 ft. high at each end of the room, support an arch roof, the ceiling of which is blue-tinted and laid out to represent the Constellations of the Heavens, in their true relativity of direction. At night the ceiling is illuminated so that the individual stars which are represented correspond in intensity exactly with the corresponding stars in the Heavens.

The floor level of the main concourse was established as identical with the level of the mezzanine floor of the Interborough Subway Station, since investigation had developed that about 80 per cent of the passengers

GRAND CENTRAL YARD, NOVEMBER, 1906, FROM SAME SPOT AS VIEW ABOVE

Before electrification and new construction took place, cross streets from 42nd Street to 50th Street were entirely closed except for foot bridges over the terminal yards. Except for trackage purposes the property was useless and surrounding district was largely undeveloped. Hotel Belmont is the only building common to both views.

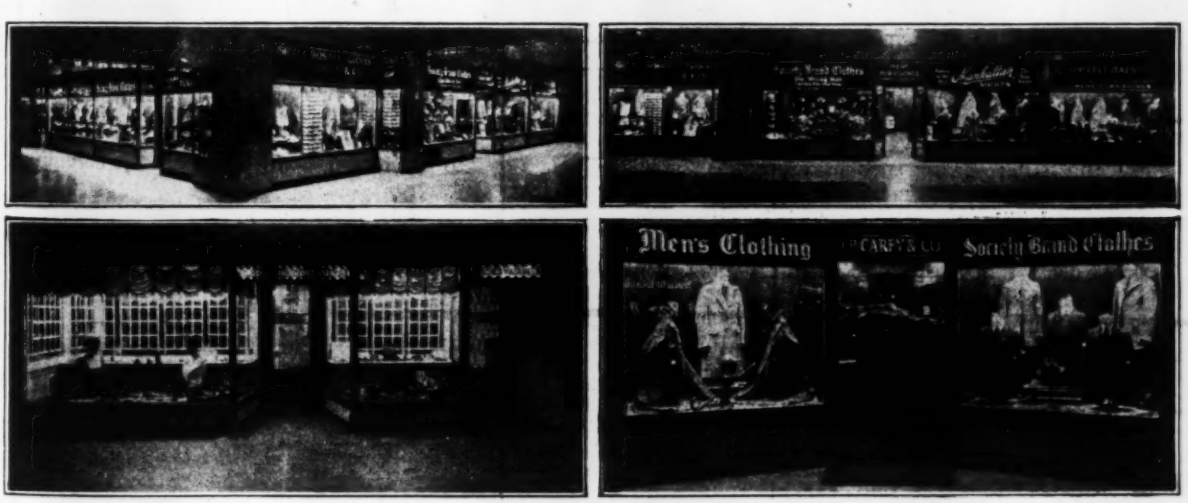
entering and leaving the terminal use the subways. From the concourse may be reached almost directly the incoming station, the Commodore and Biltmore Hotels, the Yale and Princeton Clubs, the Vanderbilt Concourse Offices, the offices of the two railroad companies, as well as the subways and various shops and numerous other facilities located in the main building for the convenience of travellers. These connections are indicated clearly in the accompanying insert showing sections of the upper and lower concourse levels and the street level.



MAIN CONCOURSE IS ONE HUNDRED AND TWENTY-FIVE FEET HIGH

With length of 275 ft. and width of 120 ft., room could accommodate thirty thousand people. Ceiling laid out to represent "constellations of the heavens" in true relatively of direction and illumination. Main entrance at the left and train gates at the right.

The incoming station, located beneath the Biltmore Hotel, to the west of the main concourse and separated from it by a passageway beneath Vanderbilt Ave. on a level with the main concourse, has separate passageways leading to the subways, the street and the cab driveway (also located under the hotel) so that passengers arriving in the terminal will not interfere with the flow of people on the way to trains. A stairway from the incoming station leads directly up into the Biltmore Hotel, the use of which was originally intended for travellers but which has become a popular "society" hotel. Soon the need became apparent for an additional hotel connected directly with the main building to serve the convenience of travellers, and the project was launched to build the Commodore Hotel on the corner of 42d St. and Lexington Ave., with 2,000 rooms in addition to the 1,000 rooms in the Biltmore. This elaborately appointed hostelry, with its great lobby giving the impression of Babylonian hanging gardens, is reached directly from the main building passageway to the east of the concourse. The railroad offices in the head building, connected by overhead bridges with the railroad office building surmounting the Post Office, are reached directly by two sets of elevators on each side of the train gates directly off the main concourse. A private underground entrance to the Yale and Princeton Clubs connects with the Vanderbilt Ave. passageway to 45th St., which also gives direct access to the Vanderbilt Concourse Offices adjacent to the building occupied by the two university clubs. All of these passageways, on a level with the main concourse, connecting it with the street, subway and building entrances, are brought into their fullest use by virtually making them "inside streets" on which may be found shops and stores dealing in almost every conceivable want that would occur to any one using a passenger terminal—or for that matter to almost any shopper. Here are found small places of business which deal not only in the usual commodities on sale in any passenger terminals but also in musical supplies—even pianos—haberdashery and clothing,



SHOPS ON THE "INSIDE STREETS" OF THE MAIN BUILDING

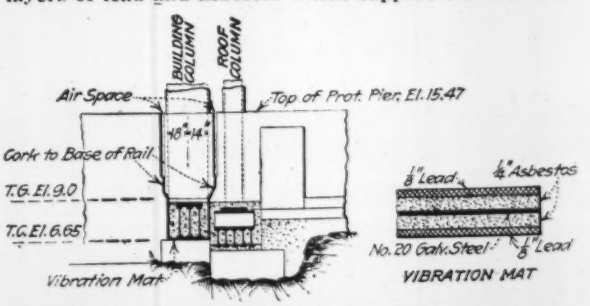
ORIGINAL PLAN FOR PARK AVENUE DEVELOPMENT

Only nine years ago it was not thought that building over yard tracks at this point would exceed six stories in height. Already a thirteen story apartment building has been erected and a thirty-one story office building is projected.

ladies wear, electrical appliances—including electric washing machines—luggage and trunks, stationery and printing, dried fruits and nuts, and French pastry. Here may also be found a shoe repair shop, a shop which deals exclusively in safety razors and shaving accessories, a milk and dairy stand, a delicatessen store, elaborate candy shops, a circulating library, drug stores, lunch counters and restaurants, and a sub postal station. At first the development of the business of these shops was slow, but in the past few years it has increased by leaps and bounds. Last year the company operating the haberdashery and clothing shops in the terminal building did a business amounting to very nearly one-half million dollars, and the indications are this year that gross receipts will total somewhere near three-quarters of a million.

Far more important than these concessions inside the main building, from the viewpoint of revenue-production, is the development of the "air rights" over the yards to the north, and the opening of Park Ave. With Park Ave. opened throughout its entire length by building the cantilever viaduct over 42d St., and by carrying the elevated roadway around the west side of the station, and thence northward on its normal course over the terminal yards, a great plaza is opened north of the head building. Outstanding among buildings located almost entirely over the terminal tracks to the north of the head building is the Mansions Apartment House (more popularly known as the Paterno Apartments) consisting of two sections of thirteen stories each, located on the rectangle bounded by Park and Madison Aves., and 47th and 48th Sts. This building, which was completed in 1918, contains 104 apartments, 23 stores, 10 doctor's offices, and 65 extra servant's rooms, and brings in a total annual rental of $1,100,000. Upon entering its courtyard consisting of an elaborate formal garden it seems almost inconceivable that it is built over the yards of a railroad terminal. Similarly appointed apartment houses, but of smaller size, are located over the two plots on the west side of Park Ave., between 50th and 52d Sts. Another apartment house which will bring in a total annual rental of $900,000 is now being constructed by Fred T. Ley & Co., Inc., on the plot bounded by Park Ave., the extension of Vanderbilt Ave. and 48th and 49th Sts. The building has been financed on the co-operative ownership and management plan without the aid of a mortgage and is the first application of the co-operative plan to an apartment dwelling of such large size. Still another apartment building, which will also bring in a rental of $900,000 per year, is being built between Park Ave., the extension of Vanderbilt Ave. and 49th and 50th Sts. Louis Sherry's restaurant will be one of the features and will occupy the entire ground floor of this building. The number of occupants in these two apartment houses will be from 500 to 600 each and the number in the Paterno Apartments is approximately 1,000.

It was the original plan of the Park Ave. development that the buildings at this point would not exceed over six stories in height, but even the apartment houses mentioned above exceed this limit. During the first part of the new Grand Central construction work, the steel columns carrying the express tracks and overhead streets were erected to serve as building columns as well. It was decided to make the remainder of the columns carrying railroad and street structures entirely independent of building columns, which in turn would be entirely separate from the structure carrying the express tracks and street levels. This decision was reached for two reasons: First, that the demand for building space in this district had so far exceeded expectations that building columns capable of supporting much taller structures than six stories would be necessary, and second, that it would be highly desirable to have the building columns entirely independent of the rest of the structure so that they could be thoroughly insulated against vibration and sound from the moving trains beneath. A plan for accomplishing this purpose was evolved after extensive tests made by the engineering department. In these tests the effect of vibration from trains was measured in three planes by seismographic instruments. The protection evolved for all building columns supporting "high grade" structures is indicated in the accompanying drawing, which shows the details of the vibration mat consisting of alternate layers of lead and asbestos which support the column at



BUILDING COLUMNS PROTECTED FROM VIBRATION

Surrounded by air space and supported by mat of alternate layers of lead and asbestos to insulate buildings against sound and vibration of moving trains.

POSSIBILITIES OF FUTURE DEVELOPMENT OVER YARDS SUGGESTED BY DIVERSITY OF PRESENT BUILDINGS
Left: Group includes railroad offices, hotel, university clubs and business offices, all built over yard tracks. Right: Modern apartment house over tracks, which brings in total rental of $1,100,000 yearly. Vacant rectangle is site for thirty-one story office building.

its base, and the air space which separates it from the railroad structure. By far the greater portion of the steel now in place supporting the railroad and street structures is designed for that purpose only and not to aid in carrying building loads, but the track layout was, of course, made to permit the erection of building columns without interfering with clearances.

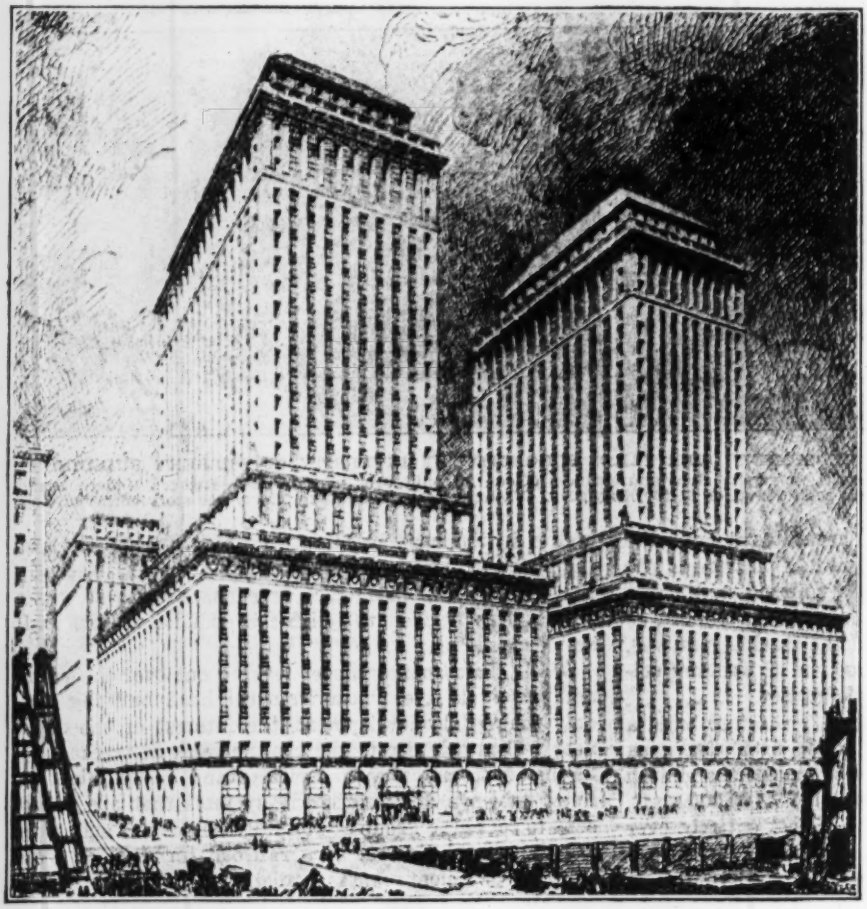
Great interest now attaches to the project to build a twin office building 31 stories high over the area bounded by Madison and Park Aves., and 46th and 47th Sts. This building, which will provide 1,100,000 sq.ft. of office space, will, as planned, be almost entirely over the terminal tracks. It is being projected on the co-operative plan by the Weaver-Crawford Corporation, with Douglas L. Elliman & Co., Inc., managing agents. The total annual rental of the building will amount to about $4,154,000 and of this amount $1,454,000 will be derived in rentals from non-owners who will lease their space from year to year and the remaining $2,700,000 will be derived from the sale outright of office space to subscribers or co-operative owners. This project will involve nearly $35,000,000, consisting of an estimated construction cost of $18,900,000 and a twenty-one year lease for about $15,000,000 with two renewals. Already a considerable proportion of the stock in the new corporation has been subscribed and it is intended to begin construction within a few months. The structure will be 31 stories high on the Madison Ave. end and 18 stories high on the Park Ave. end, these sections being connected by a wing seven stories high over Vanderbilt Ave. It is also contemplated to erect a 25-story office building over the area bounded by Madison and Park Aves., 45th and 46th Sts.

The Grand Central Palace, between Lexington Ave., 46th and 47th Sts. and Depew Place, was built during the original construction. It was intended and is now used largely as an office and exhibit building for manufacturers and their associations. On the rectangle immediately to the south of the Grand Central Palace is the mail service and office building now consisting of 4 stories in which are the executive offices of the New York Central Railroad. To the present building is now being added 13 stories which will afford space for all the New York Central offices and those of the New Haven road which are in New York City. This will release all of the office space now occupied by New York Central offices in the Post Office and office building. At present most of the office space occupied by the New York Central is in the head building, in which a small part of the space is now leased to private concerns. Recently the demand for office space here has become so great that it was decided to build the addition to the mail service building.

While the casual sightseer looking out over the yards and the Park Ave. Plaza from the head building sees only the visible development, the interest of the engineer will attach also to the vast network of tracks, signaling systems, power, heating and communicating lines, subways and ventilating systems that are necessary to serve the group of buildings as a whole and operate the Grand Central as a railroad terminal as well. Since no basement room is available in the buildings surmounting the area of trackage it was necessary to provide central power and heating plants, with an elaborate system of distribution under the lower level. This may be said to be one of the distinctive features of the plan. The fire signal system that has been installed is comparable to that of a small modern city.

The distinctive feature of the track layout of both levels is the system of loops shown in the accompanying insert. Although connections of the upper level loop and the outside loop of the lower level are not yet complete on the east side of the layout north of 45th St., it is the ultimate plan of operation to have the incoming trains enter on the west side and run out around the loop tracks so as to avoid cross-over movements at the throat of the yards above 50th St. This will greatly increase the traffic capacity of the terminal as the demand is increased above the 600 trains a day which now enter and depart. Since practically all of the suburban traffic is handled on the lower level, provision was made for an inner loop, having much sharper curves, around which can be operated only multiple unit electrically driven cars on account of the short radius. This loop is now in use. Of course, it is not necessary to pull all of the empty trains out to the Mott Haven Yards, on the other side of the Harlem River, for cleaning since the terminal layout includes a large area of storage tracks in addition to the network of running tracks and the platform tracks.

To operate the complicated network of trackage it was necessary to devise a signaling system for each level that could be operated by a director who could not possibly see the train movements. The main signal tower—a tower below the street level at 49th St.—is a 4 story building that houses the interlocking ma-



THIRTY-ONE STORY TWIN OFFICE BUILDING OVER RAILROAD YARDS

Building of which is now being projected as co-operative corporation, formed by owner-tenants, holding option on "Air Rights" above tracks.

chines that operate the switches and signals. Each level is controlled by a director who has before him a facsimile diagram of the track layout on which movement of trains between switches and fouling points is indicated by small electric lights. The signal machine for the suburban level is the largest ever constructed and has 400 levers, each of which operates a switch or signal, and on the floor above, the machine for the upper level has 362 levers. To each 40 levers a man is assigned who works under the instruction of a train director. An incoming train is announced to the director by telegraph from the interlocking station at Mott Haven Junction stating the kind of train and what time it is being sent. When the train has passed down Park Ave. as far as 72d St. an electric light located on the director's desk informs him that the train has passed that point, so that the director may decide upon what track to receive the train and then call his orders to the levermen accordingly. The moment the incoming track is determined upon this information is transmitted from the signal tower by a telautograph to similar instruments located in other parts of the terminal. One of these informs the attendant at the incoming bulletin board of train movements for the convenience of people meeting friends. Other recording instruments at various points notify the 200 station porters of the approach of all through trains.

The signal system, which is as nearly automatic as is possible to make it, may be termed the nerve center of the railroad terminal proper for without it there could be no movement of trains over the vast area in which movements can hardly be seen from one track to another at some points. The signal and switches interlock both mechanically and electrically. Alternating current track circuits are used in lieu of detector bars and there is a complete spare set of these connections to insure continuous service. The track circuits are used to prevent the operation of switches while trains are moving over them and to indicate the presence of trains within the limits of fouling or danger zones These circuits are also used to operate electric locks which automatically hold the levers in position. The lock is released only when there are no trains on the track between the fouling limits. Alternating current track circuits are necessary on account of the 660 volt direct current circuit made through the track and third rail for electric motive power.

The extent of the power and heating plant facilities serving the terminal layout is indicated by the fact that on the coldest days the coal consumption reaches 500 tons, and the average boiler load per day during a cold month is about 5,000,000 lbs. of steam, equivalent evaporation from 212 degrees. The average coal consumption in the winter months is 390 tons per day. Both steam and hot water heating systems are used and the hot water mains alone have a total length of over four miles, with pipes from 14 to 18 in. in diameter. A complete refrigerating plant is also included in the power units. The 50th St. power plant is the main heating unit for the terminal. It is equipped with fourteen 600 hp. boilers, steam from which passes through the surface heaters of the hot water system. Although lighting current for the entire terminal is derived from a complete electrical substation in the 50th St. plant, consisting of four rotaries for lighting and power purposes besides six rotaries for railroad purposes, steam from the boilers is first used to operate turbines driving direct-current generators, and exhaust steam from the turbines is passed through the hot water heaters in order to increase the efficiency of the unit. From the 50th St. plant hot water for heating purposes is driven a mile in its circuit to most of the buildings in the group including the main station building the incoming station, the terminal offices, the Post Office, general office building, the Vanderbilt Concourse Offices, Grand Central Palace, the Yale Club, the Biltmore Hotel, the Express Building and the Y. M. C. A., the last being in the same block as the 50th St. power plant. Three

stages of pressure are necessary to provide for the great height to which hot water is raised in connection with heating the Biltmore Hotel.

Subsequent to 1916, the desire of tenants in new buildings to be erected to use steam for heating purposes led the management to erect an additional boiler plant under 43rd St., from Lexington Ave. to Depew Place. This plant, which has space for six boilers of more than 1,400 hp. each, is located 90 ft. below the street level. The excavation for it involved the removal of 36,790 cu.yd. of solid rock. The two boilers now installed, while having a direct emergency connection with the 50th St. power plant, are used for generating steam heat for the Commodore Hotel and may also be used to heat the Hotel Chatham and the Paterno Apartments. During the winter, the average steam consumption per month of the Commodore Hotel alone is 36,000,000 lb. equivalent evaporation. It is interesting to note that the smoke stack for this power plant is virtually included in the Hotel Commodore itself, being located in a corner of the west wing, leaving two vertical rows of windows blank on each side. The stack is carefully insulated from the adjoining structure, so as not to overheat hotel rooms. The coal and ash handling systems of the 43rd St. Power Plant are entirely mechanical. Coal is dumped by motor truck through the street manholes into the bunkers, which have a capacity of 2500 tons, from which it is delivered by gravity to the automatic chain grates. Ashes are delivered mechanically to an overhead conveyor which loads into cars on one of the loop tracks above. The lowest point in the whole terminal is the sump in the floor of this plant, at an elevation of 57 ft. below mean low water, or 100 ft. below street level.

Anyone who is shown the power plant facilities of the Grand Central cannot but be impressed with the extent to which engineers have gone in furnishing spare units. One of the boilers in the 43rd St. Power Plant itself is a spare and the plant as a unit, in case of emergency, might be used as a spare for a portion of the 50th St. plant by direct steam connection. This phase of planning for continuous and uninterrupted service is also carried out in the electrical equipment. Just above and adjacent to the 43rd St. plant is located a 2,000 kw. rotary converter, which may be used as a spare at this point in addition to those installed in the 50th St. plant. Thus continuous service is rendered the power and lighting load which in January, 1920, amounted to 2,115,000 kw.-hr.

The complete refrigerating plant is located adjacent to the suburban loops and on the same level near the southeast corner of the main building, as indicated in the accompanying insert. It provides refrigeration for the cold-water system extending throughout the terminal office buildings, furnishing water at 45 deg. F. The plant also serves various soda fountains and ice cream stands and other minor facilities throughout the terminal. It is equipped with three compressors with a total capacity of 60 tons of ice per 24 hours. Two auxiliary compressors with a capacity of 20 tons are also provided.

The express waiting room, the suburban concourse and the incoming station are ventilated and heated with tempered air delivered by twelve blowers with a total capacity of 648,000 cu.ft. per minute. The blowers and air tempering units are located on the suburban track level in various spaces between the

OFFICES ULTIMATELY TO BE BUILT OVER CONCOURSES
Present structure designed and built to carry seventeen story building. Columns weigh approximately one ton per linneal foot

main and loop tracks below the suburban concourse. They are all electrically driven. No air is delivered from the blowers to the main concourse direct, since circulation in this room is accomplished through the large openings above ramps leading to the lower level.

When the terminal was built it was necessary to construct a separate sewer under 46th St. about 40 ft. below the street level to drain the suburban track level. In addition to this sewer there are three sewage ejectors located in sumps just below the suburban track level near the southeast corner of the main building from which sewage is received and raised to sufficient height to be carried off. There are also four sumps for receiving drainage water which is pumped up to the water system.

Subways for the handling of baggage, mail and express below the lower level are at the lowest elevation of any of the terminal passageways, being between 50 and 60 ft. below the level of the street. The location of these passages is shown in the accompanying insert. Here all of the baggage, mail and express received and sent out of the terminal is transferred to and from the individual tracks of the upper and lower levels by means of elevators connecting with the subways, so that there is a minimum of baggage trucking on the train platforms. Also on this sub level are found fire proof oil rooms and lamp rooms used by the trainmen. Throughout all of the levels of the terminal are fire stations—96 in number, divided into four districts—each indicated by a blue light marking a signal box and all connected to a main switchboard in the terminal office building and through it to the city fire alarm system. An alarm turned in is sounded in all parts of the terminal indicating its exact location. Frequent fire drills are held to maintain the efficiency of the great force of terminal employees as emergency fire fighters. With this protection it seems

inconceivable that a fire should ever gain any headway in any part of the great fireproof structure.

Primarily a great center of transportation and transfer with direct connection between the New York Central and New Haven railroads, the Lexington Ave. and Times Square routes of the Interborough Subway, and the Belmont Tube to Queensboro and Long Island, the Grand Central stands today as a remarkable civic development for which there is no precedent. Although its traffic capacity has by no means been reached and the development of the whole is still incomplete, the terminal is used daily by 50,000 to 100,000 people besides 111,040 arriving and leaving on trains. One of the surprises to the management is the result of actual counts of people who do not use trains but still pass in and out of the terminal. Of the daily train passenger traffic about 65,480 are suburbanites, and this portion of the traffic is steadily increasing. The number of passengers in and out of the station on trains in 1903, at the beginning of reconstruction, was 16,135,667 —or 44,200 per day—as compared to 32,338,053 in 1919—or 88,500 per day.

Additional building already planned for the Grand Central property indicates the increasing value of land connected with the greatest transportation center in the United States. While there are no definite plans yet developed for building over some of the vacant rectangles, the growing demand for Grand Central property points to the building up of the whole area, many projects for which are under consideration.

Sales of Garbage By-Products at Chicago

Disposal of the byproducts of the Chicago municipal garbage plant by private sale without advertising for bids has led to an investigation by the Chicago *Tribune*, which arrives at the conclusion that the city is a loser by this method of handling the business as the material is sold below current market prices. It appears that in 1918, under war conditions, the finance committee reported that the market value of the byproducts fluctuated so greatly that the city's revenue was smaller from contracts made after advertising for bids than it would be from direct sales made according to market conditions. On this recommendation the city council authorized the commissioner of public works to sell the byproducts according to market conditions by agreement with parties "who will pay the highest price, upon competitive bids obtained without advertising."

In March, 1920, the finance committee recommended a change to the original practice and the council passed an ordinance providing that bids for the sale of the byproducts should be advertised for and submitted to the finance committee. This ordinance was vetoed by the mayor on recommendation of Mr. Francis, commissioner of public works, the reason given being that advertising "prevents rapid disposal at current market prices and opens the door to contract relations with discredited and irresponsible combinations of dealers."

The present purchaser, who was formerly connected with a reduction company whose plant was purchased by the city, is reported as stating that the reason for the relatively low price paid to the city is that its garbage byproducts are inferior in quality to those of other cities. He buys it as it comes, without making analysis, and sells it on the buyer's analysis.

Proposed Water and Sewer Districts in Cuyahoga County, Ohio

By R. F. MacDowell
Division Engineer, Morris Knowles, Incorporated, Cleveland, Ohio

TO PROVIDE badly needed water and sewerage improvements for a large unincorporated area just outside of the city of Cleveland the County Commissioners of Cuyahoga County recently created two large county sewer districts and retained MacDowell & Garvin, Sanitary Engineers of Cleveland, to make a preliminary investigation and report.

The State Law under which these sewer districts were created was enacted for the purpose of providing water and sewer improvements for built-up territories outside of cities and hence not under the jurisdiction of the municipalities. The law gives the County Commissioners authority to define the limits of the district, to design the improvements, and to raise funds for their construction by special assessment upon the property benefited.

County Sewer Districts 1 and 2 in Cuyahoga County cover about 27,000 acres to the southwest of the city and were laid out along topographic rather than political boundary lines in order to simplify the problem of sewerage design.

The report, which was submitted on June 1 by MacDowell & Garvin, Cleveland, Ohio, recommends a general plan of trunk and intercepting sewers for each of the districts, all of the sewage in each district being conveyed by means of these sewers to a single point for treatment. The sewage-treatment plant for District 1, the westerly district, would be constructed, under the plan recommended, just inside the corporate limits of the city of Cleveland in the valley of Big Creek. This plant can be made to serve not only this sewer district but an area of about 1,250 acres within the city limits, as well as a large portion of the village of West Park. It is estimated that the plant at this site, comprising sedimentation tanks and contact filters, would be satisfactory for a period of ten to fifteen years in the future, at the end of which time the plant could be enlarged and the tank effluent conveyed either to the Cuyahoga River or to Lake Erie.

It is recommended that the sewage from District 2 be treated by means of a plant comprising sedimentation tanks and sprinkling filters, located in the valley of the Cuyahoga River, and constructed by the county. This plant would also serve for a period of ten to fifteen years, at the end of which time the sewage could be conveyed by means of a siphon across the Cuyahoga River to the site of the proposed southerly sewage treatment plant of the city of Cleveland.

It is estimated that the trunk sewers and sewage treatment plants for these two districts will cost in the neighborhood of $2,500,000.

The report recommends that the water supply for the two districts be secured from the city of Cleveland. However, on account of the high elevation of a large portion of the districts above Lake Erie it would be necessary to construct booster stations and reservoirs within the district to supplement the city water-works system. It is estimated that the water-works facilities, including the main water lines, pumping stations and reservoirs to serve the district until 1960, would cost some $1,100,000.

Although the improvements as recommended would be built by the county they would be designed with a view to their operation and maintenance by the City of Cleveland in the event of annexation of the area by the city at some time in the future.

Building Highways to Meet Demands of the Subgrade

By F. A. Churchill
Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio

A BUILDING is no better than its foundation. A highway is no better than its subgrade. A great deal is being said, pro and con, about building highways to bear the load. On the other hand, legislative steps are being taken to limit all loads to the capacity of inferior roads. At present the first proposition seems to involve construction so heavy as to be prohibitive in cost. The alternative imposes a handicap on the development of transportation and retards progress. The primary purpose of all traffic lines, whether rail, water or highway, is to meet the transportation needs of the country. Restrictions of transportation are contrary to public policy.

Nevertheless a temporary compromise must be adopted. Roads built for pre-war traffic cannot sustain the 15-ton truck loads of the present. Unless a safe limit be put on unit loads a vast mileage of hard-surface roads built in years past will soon be ruined. Some form of traffic regulation must be adopted in order to save such roads. But the alternative for new road construction is not necessarily massive construction.

Must Consider Soil in Subgrade

The solution of the problem does not seem to be more material but more knowledge—not heavier designs of surfacing but accommodation of beams to soil conditions. This involves flexibility in designs. The practice of designing uniform construction for all parts of a road, regardless of differences in soils, is the source of many failures in roads. Engineers who have studied the subject intelligently agree that most of the failures of brick highways have been due to defective subgrades. Experiments have demonstrated that an 8-in. slab—4 in. of vitrified brick and 4 in. of concrete foundation united in a monolithic beam—if properly built will sustain almost any traffic load if the supporting subgrade be stable and uniform.

Drainage is highly important. Too much stress cannot be laid on that point. But draining alone, as it is now done by almost uniform specifications, will not suffice. It is difficult in any case to prevent moisture from entering a subgrade, either from capillary action or by seepage; but different soils require different treatment. It is of the utmost importance to know your soil and to know how it acts under the influence of different degrees of moisture content.

Very few highways have uniform soil conditions. There may be gravel that drains readily, and sand that compacts easily, and sand that refuses to compact, and clay that retains moisture persistently, and quicksand that when saturated is as unstable as quicksilver.

Very frequently all these conditions are found on a single road. It is therefore manifestly absurd to design a uniform slab for such a road. On some portions of the road a 7-in. beam would suffice for any traffic. On other sections of the road a 12-in. beam might be required, while on the worst sections heavy reinforcement might be necessary. Nor would the question of drainage be less complex. Instead of emphasizing building roads for the traffic, better results will be obtained by building roads for the soil. If we do that, the traffic problem will solve itself. This, of course, presupposes the building of a high-class type of road that in itself has strength and wearing qualities. If there is on a road only one spot of poor soil, however short, the design should be changed to meet the conditions, and changes should be made wherever poor spots occur.

Proof of the folly of building uniform surfacing for various kinds of soil is furnished by one of the most important Federal-aid projects in Ohio. Main Market road No. 1, traversing the northern tier of counties from the Indiana State line to the Pennsylvania State line, was paved 12 mi. from Ashtabula to Conneaut in 1919. Construction was monolithic, 5 in. of concrete foundation and 4 in. of wire-cut lug brick. The road was completed in the fall of 1919. During the winter of 1919-1920 heavy snows covered the road from mid-November until late in the spring. Snow came before hard freezing, so that there was hardly any frost in the ground, not deeper than 1 in. when the snow went off.

An inspection in May, 1920, showed the road to be in perfect condition, even in low-lying places, with the exception of three sections where wide longitudinal cracks appeared. The cracks were in the highest part of the crown, and in one instance extended for ½ mi. in length.

A careful examination of the road and diligent inquiry into natural conditions developed the facts that although the defective sections were at least 4 ft. above the bottom of the side ditch and were underdrained with tile the sub-grade contained quicksand. No evidence of frost heaval was discoverable, but the north half of the pavement had settled appreciably and caused the slab to break, by its own weight and the weight of heavy trucks, along the median line. The pavement was laid during hot, dry weather, when the quicksand was firm; but moisture created by melting snows had evidently given the quicksand almost a fluidic consistency, leaving the slab practically unsupported by the subgrade.

If the road had been built with an intelligent understanding of existing soil conditions the weak sections could have been strengthened either by increasing the depth of beam or by reinforcing the foundation.

Instance of Faulty Design

A similar instance is that of the Cleveland-Akron brick road built of a uniform thickness on firm soil and over marshy ground. Where the subgrade was firm the pavement sustained enormous traffic without damage, although the road was constructed during the period of only moderately heavy truck traffic; but the sections built over yielding soil broke down so completely that reconstruction was necessary.

Doubtless other cases at point could be cited, but these examples should teach engineers: (1) To study the soil of the subgrade; (2) to design the pavement to suit the varying conditions of subgrade; (3) to adapt the drainage system to the nature of the soil, as well as the lay of the land. It is obvious that comparatively light construction will serve where the sub-

grade is dry, firm and unyielding, but that heavy construction is advisable when the nature of the subgrade makes it necessary for the beam itself to supply a large part of the load-bearing strength.

Study of soil has been neglected in the past. In fact soil as an integral factor in pavement construction never received serious consideration until the war brought heavy trucking over highways into the problem, and it is only very recently that soil study in relation to road building has been taken up in the spirit of scientific inquiry.

The U. S. Bureau of Public Roads, the Federal Highway Council, state highway departments and other bodies have at last undertaken research work with a view to acquiring accurate data regarding soils, as a basis for scientific road building. The Bureau of Public Roads has done some field investigating, making borings where high-class road surfacings have broken down, and conducting laboratory analyses of soil specimens so obtained.

So much attention has been given in years past to improvement of road surfacing methods that engineers and others in interest have overlooked the fact that the only really permanent part of a road is that which supports the metal. Surfacings wear out in time but the grade ought to be so constructed as to remain indefinitely, serviceable for resurfacing several times. Improving a highway is a structural problem akin in principle to the erection of a lofty building. In either case the stability of the superstructure depends on the rigidity of the foundation and its natural support. Architects and builders do not figure on the same style and weight of foundation for all kinds of subsoil. Roadbuilders should be equally discriminating in the matter of foundations.

Maintenance on English Roads

DURING the year ending in March, 1920, maintenance upon the Essex, England, county main roads, aggregating 672 mi., cost the county authorities, according to the annual report of the county surveyor and recently reported in the *Surveyor*, a total of £162,065, or an average of $1,170 per mile. Essex County main roads total 788½ mi., though 116½ mi. are under urban authority, making the length under the direct control of the county council, 672 mi.

Some difficulty was experienced in the maintenance of the Essex roads owing to the lack of railway transportation for the conveyance of granite and the small quantity possible of delivery as compared with requirements. The railway strike of September, 1919, imposed an additional strain upon the roads at a time when they were least able to stand it. Several of the Essex roads suffered to such an extent that complete reconstruction will be necessary, one of such roads being the one from London to Ipswich running through the center of the county. To restore this road alone, which is but 33 mi. in length, an expenditure of £132,000 will be necessary, it is estimated, exclusive of the cost of repair to damaged bridges.

As an indication of the traffic carried by some of these roads during the railway strike, statistics taken in November, 1919, show that on one occasion, about 2 a.m., a fleet of 39 loaded trucks, representing 585 tons, passed an observation post on the Chelmsford-Colchester road at intervals of 45 seconds.

Flood Check Dams Formed by Fil Behind Wire Frame

New Type of California Dam Automatically Fil With Flood Debris Which Causes Barrier

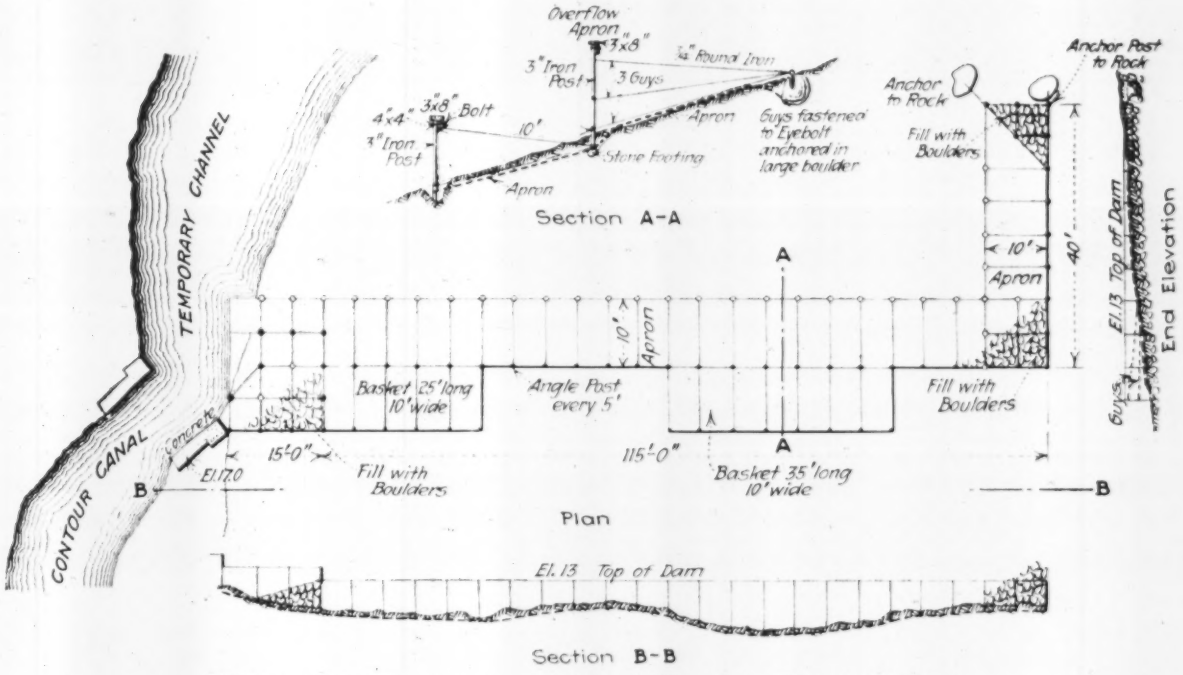
TO CHECK the velocity of streams in flood times an to store the surplus water which flows down th sandy and porous California river beds there hav been built lately some special dams known as "Pra Porous Dams," after their designer and builder, A. A Pratt, of Los Angeles, Cal. They consist of a gaged

DAM FRAME COMPLETED. NOTE NATURE OF THE RIVER BOTTOM

wire frame stretched across the dry bed of the stream behind which frame there builds up during a flood a mattress of debris which constitutes an effective barrier to the water.

The views and drawing herewith are of such a dam built for the Water Conservation Association of River-

PASSING A FLOOD OF 1 FT. ABOVE DAM



DETAILS OF PRATT POROUS DAM FOR SANTA ANA RIVER, CALIFORNIA

side, Cal., on the Santa Ana River. Here there is a narrow contour canal with a wide adjoining flood water channel which for the most of the year is dry with a bed of heavy boulders, gravel and sand. It was desired not only to check the occasional floods which overflow the channel, but to store these surplus waters which would then sink into the gravel of the debris cone to replenish the San Bernardino artesian basin below.

The dam extends 130 ft. across the channel with a wing 40 ft. long and has a main barrier for its whole length with two supplemental front barriers for a part of the length as shown.

The dam is constructed of iron posts or angle irons set into the bed of the stream and standing about 6½ ft. above the bed and about 3 ft. deep. These posts are guyed upstream by heavy wires to anchors set in boulders in the bed of the stream. The lower line of posts for the supplemental sections are set on the bed of the stream but not below the surface. They are guyed upstream as in the main dam. Upon these posts transverse angle irons are bolted forming a frame on which wire mesh is stretched. The mesh in this case was made of ½-in. wire with 6-in. mesh The wire mesh is carried upstream above the river bed for about 16 ft. and boulders laid upon the apron so formed.

The dam itself is built on a gravelly river channel which had no water in it at the time the dam was constructed. There is no bedrock anywhere near the dam, either below it or at either end. During times of heavy rain boulders, sand and gravel are carried downstream in large quantities. During periods of high water this stream runs from 4 to 8 ft. deep and ranges from 1 to 500 ft. wide, with a gradient of approximately 200 ft. to the mile.

After the water reached this dam it took about half a day for it to fill to the top of the dam and on Feb. 22, 1920, the water reached a height of 4 ft. over the top of the upper dam. When the picture of the flood was taken, Feb. 23, the water had receded to about 1 ft. over the top. An inspection made of the dam after the water had subsided shows that it suffered no damage.

In explanation of the action of the dam, Mr. Pratt says:

"The difference between the porous type and the solid type is this: Water impounded behind a solid dam becomes a reservoir. Over the surface of this resevoir all floating debris is carried until dropped over the crest of the dam. All matter in traction is deposited at the place of contact between the active stream and the quieter waters impounded by the dam. No deposits is made at the back of the solid dam, except pervious silts.

"Behind a porous dam no water is impounded, at first. But as the water passes freely through the structure the floating debris is caught and deposited in a mattress extending from 1 to 20 ft. upstream. As the mattress builds it is joined and cemented by the matter in traction, thus creating a solid impervious mattress commencing at the bottom and building up to the top of the dam. After this mattress is completed the overflow then acts exactly as it would in the case of the solid dam, with the difference that the back-cutting can only proceed to where it encounters the mattress previously built by the stream itself, when the menace ceases. With a solid dam, when the back-cutting reaches this same point it connects with the water percolating from the reservoir and a channel is apt to be opened under the structure which automatically enlarges until the solid dam falls."

Value of 1919 Clay Products

The value of the clay products marketed in the United States in 1919 is estimated by Jefferson Middleton, of the U. S. Geological Survey, Department of the Interior, at $260,790,000, the highest yet recorded. This is an increase of $40,216,000 compared with 1918 and of $28,277,000 compared with 1917, and is nearly $100,000,000 greater than the value ten years ago. The value of brick and tile products constituted 71 per cent and that of pottery products 29 per cent of the total.

Chicago Bascule Bridge—Design and Operating Features

Four-Truss Duplex Construction of Double-Deck Bridge—Emergency Grip Brakes—Interlocked Control of Gates, Locks, Safety Devices and Machinery

By Hugh E. Young
Engineer of the Chicago Plan Commission, recently Engineer of Bridge Design for the City of Chicago

TO MEET severe service requirements many new features of construction were incorporated in the new double-deck double-leaf fixed-counterweight trunnion bascule highway bridge of 256-ft. span over the Chicago River at Michigan Ave., which was opened in May, 1920. They have proved wholly successful, except for the division of the bridge into two separable structures set side by side and coupled together, which arrangement has not yet been put to the test of uncoupling and separate service.

Even apart from its novel design the bridge is noteworthy for its size and the exceptionally heavy traffic which it carries. It is believed to be the only double-deck bridge ever built having highways on both levels in order to provide for a separation of fast and slow traffic. Other double-deck bridges combine railway and highway traffic. A view of the bridge is given in Fig. 1.

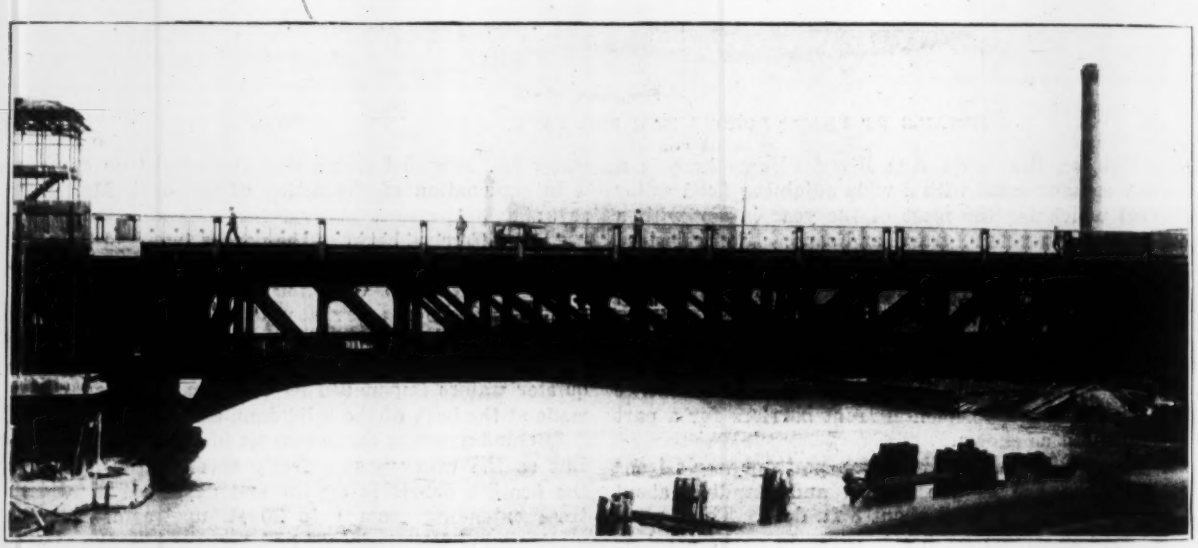


FIG. 1. DOUBLE-DECK HIGHWAY BASCULE BRIDGE OVER CHICAGO RIVER AT MICHIGAN AVE.

This bridge is the most important part of the widening and extension of Michigan Ave. between Randolph St. and Chicago Ave. to afford a wide and direct thoroughfare connecting the business district with the north-side section of the city, an improvement which eliminates the former circuitous and congested route crossing the old Rush St. swingbridge. Viaduct approaches connect the street level of the avenue with the upper roadway of the bridge, the lower roadway being for the slow and heavy traffic between various industries, terminals and steamship docks in the vicinity of the river. At the ends of the bridge the approaches are widened to form broad and ornamental plazas.

With a span of 256 ft. c. to c. of trunnions, the structure provides a clear channel width of 220 ft. Its navigation headroom was required by the War Department to be 16½ ft. from water line (city datum) for 80 per cent of the channel width with the bridge closed, and 120 ft. for the entire width of channel with the bridge open. The lower deck has a traffic clearance height of 13½ ft., while the upper deck is free of overhead obstruction. Both floors are paved with creosoted yellow-pine block paving on transverse planking bolted to the I-beam stringers. Back of the trunnions, however, the lower deck has sandstone block paving on concrete on a buckle-plate floor, in order to add weight to the tail and to give a better footing for teams on the 3 per cent grade from the street. Provision is made for the future construction of two street-car tracks on the lower deck.

Four trusses were used for each leaf, for reasons noted below. The two inner trusses are spaced 6 ft. c. to c., and the outer trusses 27 ft. On the upper deck there are two 27-ft. roadways between trusses and two 15-ft. sidewalks on cantilever floor beams. On the lower deck are two 18-ft. roadways and two 6 ft. sidewalks, all inside of the trusses. The width over all on the upper deck is 91 ft. 9 in.

Reasons for Four-Truss Construction—Two principal reasons determined the adoption of four-truss in preference to three-truss construction: (1) advantages in design and construction, and (2) the possibility of separating the bridge into two parallel parts in case of emergency. With three trusses the load on the center truss would have been approximately double that on each outside truss, which would have meant double work in designing, detailing and fabricating the trusses. The anchor arm for the center truss would have been so heavy that the shop details would of necessity have differed considerably from those of the outside trusses.

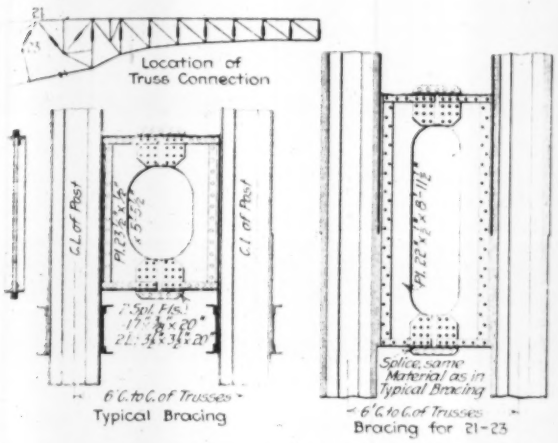

Location of Truss Connection
C.L. of Post
C.L. of Post
6 C. to C. of Trusses
Typical Bracing
Splice, same Material as in Typical Bracing
6' C. to C. of Trusses
Bracing for 21-23

FIG. 2. SEPARABLE DIAPHRAGMS CONNECT INNER TRUSSES OF FOUR-TRUSS BRIDGE

grips of rivets would have been increased and difficulties of detail encountered. The increased weight of the two center trusses over one center truss is slight, being due only to additional structural detail, as the main section of the chord and web members requires the same amount of material in both cases. The increased weight due to truss details and to diaphragms connecting the two parts is offset by cost advantages secured through the shorter floor beams and fewer stringers in the roadways. Erection would have been more difficult with a heavy center truss and light outer trusses.

Again, the trunnions for the four-truss span are all of approximately the same diameter, while the much larger trunnions of a center truss would have involved difficulties and extra cost. Further, there would have been difficulty in arranging the anchor-arm floor members to clear the journal boxes of the larger inner trunnions. The cross-girder supporting the trunnions would have required wider flanges in order to seat the bearings and this, in turn, would have made it difficult to obtain clearance between the lower flanges of the cross-girder and the truss members of the anchor arm.

The Duplex Arrangement—By using four trusses each leaf could be built in two parallel parts so constructed that each part can be operated independently. Bridges over the Chicago River frequently are struck by vessels and damaged to an extent that necessitates raising them to the open position for repairs, interrupting street traffic until these are completed. Experience has shown that in such cases the principal damage done is to the sidewalk construction and to the trusses ahead of the trunnions, and as the parts back of the trunnions are not affected it has been possible to raise the damaged leaves into the open position. If one side of the Michigan Ave. bridge should be struck by a vessel there is no doubt that the shock would be absorbed by one half of the leaf, and that the damage would not prevent the raising of this part of the leaf, leaving the remaining half available for traffic. To provide for such contingencies, therefore, the two halves of the leaves were made independent but connected at the panel joints by diaphragms split at the center and spliced to take shear loads only. These diaphragms (Fig. 2) would buckle under impact before distorting the heavy truss members to which they are connected.

It is estimated that the diaphragms at the 26 panel points could be disconnected in eight hours by a force of twenty men, including the time required to remove bolts from shaft couplings and to place bolts in the differential gears for the purpose of causing this device to act as a unit. The removal of the diaphragm plates is also included in the time given above. If it should become expedient to cut the diaphragm connections by burning it is estimated that eight men with four torches coud accomplish this in four or five hours.

This separable four-truss arrangement was applied years ago in the four-track rolling-lift bascule bridge of the Metropolitan Elevated Ry. at Van Buren St., Chicago. It has never been necessary to disconnect the two parallel parts of that bridge; as it carries only an elevated railway it is considerably higher than the street bridges, and therefore less exposed to damage by vessels. Street bridges are not only lower but also very close together, so that when there is delay in opening a bridge it is difficult to handle a ship so as to avoid striking it. Advantage will be taken of the duplex arrangement, however, in replacing the old Van Buren St. bridge by a new structure: traffic will be maintained over one half of the old bridge during the removal of the other half and the erection of the corresponding half of the new bridge. The Charles River single-leaf bridge of the Boston Elevated Ry. also has the duplex or four-truss arrangement, so as to permit of maintaining traffic on one side if it should become necessary to raise the other part for repairs.

Emergency Brakes of New Type—Electro-pneumatic emergency brakes on the heels of the trusses, which act by gripping rails fastened to concrete supports in the

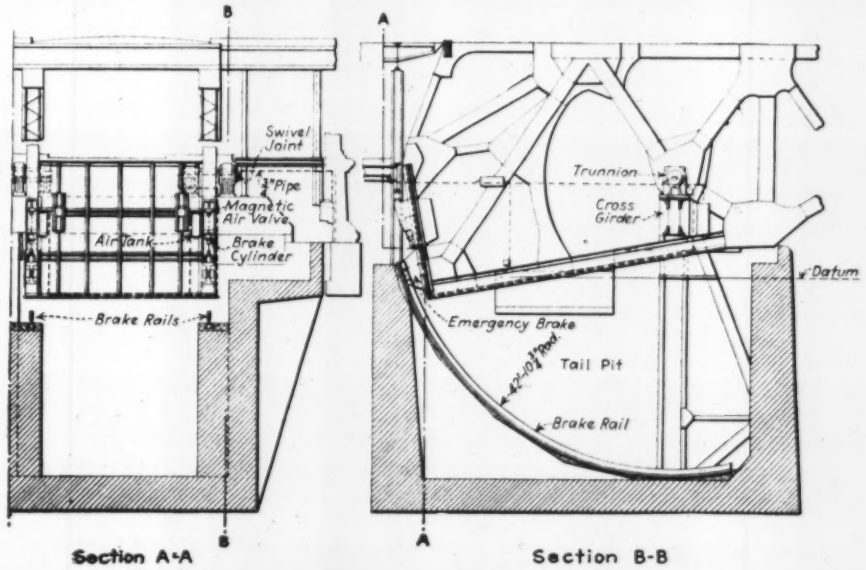


FIG. 3. EMERGENCY GRIP BRAKE ON HEEL OF BASCULE

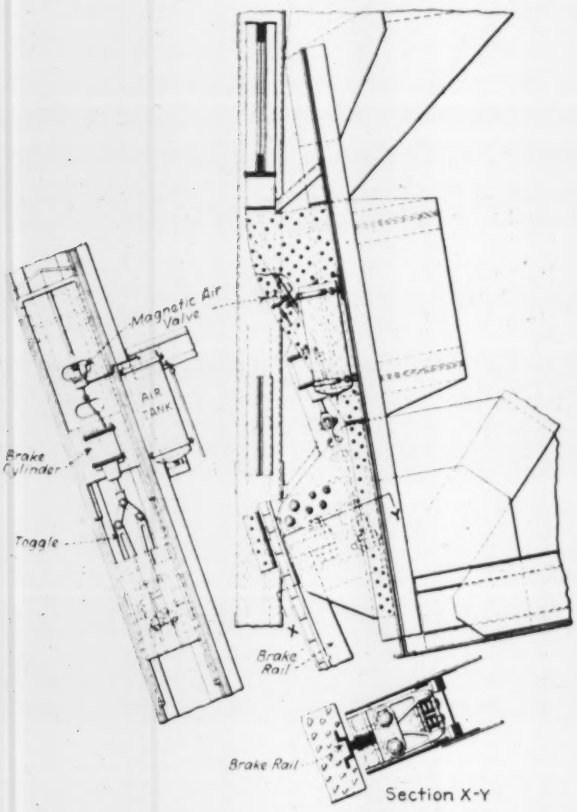


FIG. 4. DETAIL OF EMERGENCY BRAKE

tail pit, have been introduced to supplement the pneumatic and hand brakes which operate through the gear train. This is an innovation in bridge design at Chicago and is for the purpose of holding the bridge in case of accident to the machinery. The construction is shown in Figs. 3 and 4. The four brake rails are curved to the path traveled by the ends of the trusses and each is gripped by shoes operated by toggles through levers from a pneumatic cylinder 10 x 10 in., the air supply to which is regulated by a magnetic air valve controlled from the operator's house.

The grip brakes are designed to hold the leaf in any position against a wind pressure of 20 lb. on the vertical projection of the raised leaf. Under these conditions a gripping force of 95,000 lb. is exerted on each brake rail, corresponding to 6,000 lb. at the cylinder. A friction coefficient of 0.30 was used in the design.

On several bascule bridges of Chicago where the leaves are subject to unbalanced loads, and the brake arms are long, there has been a tendency for the brakes to slip, and it has been found necessary to have at least two shaft-operated brakes on every bridge. The possibility of one brake failing or being out of commission on account of repairs also argues for a second brake. Shaft brakes are operated generally by cables or rods, and failure of any one of these or an element of the gear trains suffices to put the brake out of service. There have been many instances when the braking stress in the shafts has exceeded the driving stresses, and in some instances the shafts have been badly bent due to improper application of brakes.

For ordinary spans it is considered proper to brake through the machinery, but the Michigan Ave. bridge is of such magnitude that it was considered necessary to take the extra precaution of having an emergency brake entirely independent of the shaft brakes. This consideration led to the design of the rail-gripping brake.

Trunnion and Support Problems—Loads of 1,540,000 lb. on each inside trunnion and 1,800,000 lb. on each outside trunnion required trunnions of 24½ and 26 in. diameter respectively, as shown in Fig. 5. A unit load of 1,800 lb. per sq.in. was used for the bearings, and the allowable stress in the trunnions was taken at 16,000 lb. per square inch. A cross-girder spanning the cantilever weight pit supports the trunnion bearings, as shown by the article on the substructure of this bridge in *Engineering News-Record* of July 31, 1919, p. 210. This girder is supported on the side walls of the pit instead of upon longitudinal girders outside of the trusses, the usual arrangement in Chicago bridges; the new arrangement (Fig. 6) was used for the first time in the Michigan Ave. bridge.

Elimination of the longitudinal girders gives a more efficient way of carrying the loads to the foundations and has proved very satisfactory, but with the trunnion loads carried directly on the side walls of the pits it is necessary to place concrete piers under the walls in addition to those required for the support of the pit proper. Another type of support is to have each trunnion carried by a pair of longitudinal trusses so arranged that they clear the counterweight boxes. Several bridges having the trunnion truss type of support have been built in Chicago, and their operation has been very satisfactory.

Operating Machinery—Each leaf of the bridge is operated by two 100-hp. motors, with two additional motors in reserve. These motors are located in the machinery room under the lower street level just back of the anchor pier, and are arranged both electrically and mechanically so that any two motors can be used for operation. The machinery layout is shown in Fig. 7. In the plane of the chord of each outer truss is a cast-steel internal rack of 19 ft. 9 in. pitch radius, having teeth 22½ in. wide and 7½ in. pitch, as indicated in Fig. 8. This operating scheme requires a gear train at each corner of the bridge, located just outside the outer truss and resting on grillage beams in the walls of the pit. The racks are engaged by pinions having machine-cut teeth with a pitch diameter of 33.4 inches.

The counterweight for each leaf is so distributed laterally that the correct amount required to balance the loads on each truss has its center of gravity approximately in the plane of the truss. This distribution tends to eliminate a deflection of the trusses laterally and an unequal deflection of the trusses in a vertical plane. Since the operating gears lift on the outside trusses only there is a torsional moment developed between the trusses, which is resisted by the girders of the counterweight box back of the trunnions and by transverse trusses framed between the vertical and inclined truss members ahead of the trunnions.

The diaphragms connecting the inner trusses are figured to take the entire load of one pinion in case it should be desirable to operate the entire leaf with one gear train. Normally, however, the shear in the diaphragm is neutralized, due to the action of the differential gearing. The effect of applying the operating load on the outer trusses will, of course, be the same with respect to setting the inner trusses in motion for both the leaves with diaphragms in and with diaphragms out. The diaphragms are of value only when it is necessary

to operate the leaf by one gear train, and for stiffening the bridge laterally. Under normal conditions the diaphragms will overcome the tendency of one half of the leaf to lag behind the other half, which might occur from same differences in the alignment of each half of the leaf or imperfections in the workmanship and erection.

Changes are made from the two working motors to the two reserve motors by means of friction clutches. Each pair of motors is placed so that the motor pinions of each pair engage the differential on opposite sides. On the extended hubs of the motor pinions are keyed discs which are gripped by friction clutches operated by levers mounted on the bearing frames of the armature shafts. The pinions of both sets of motors are always in mesh with the differential gears, one pinion running as an idler when the other set is transmitting power to the operating shaft. The clutches are provided to permit easy shifting of the motors, it being considered necessary to alternate the use of the motors from week to week; the particular reason for putting in the clutches was to avoid the necessity of sending to the municipal shops to get the necessary machinist to take out the bolts (in case such mechanical arrangement had been provided), which would cause considerable delay. Bridge operators are not supposed to remove bolts from couplings or any other apparatus.

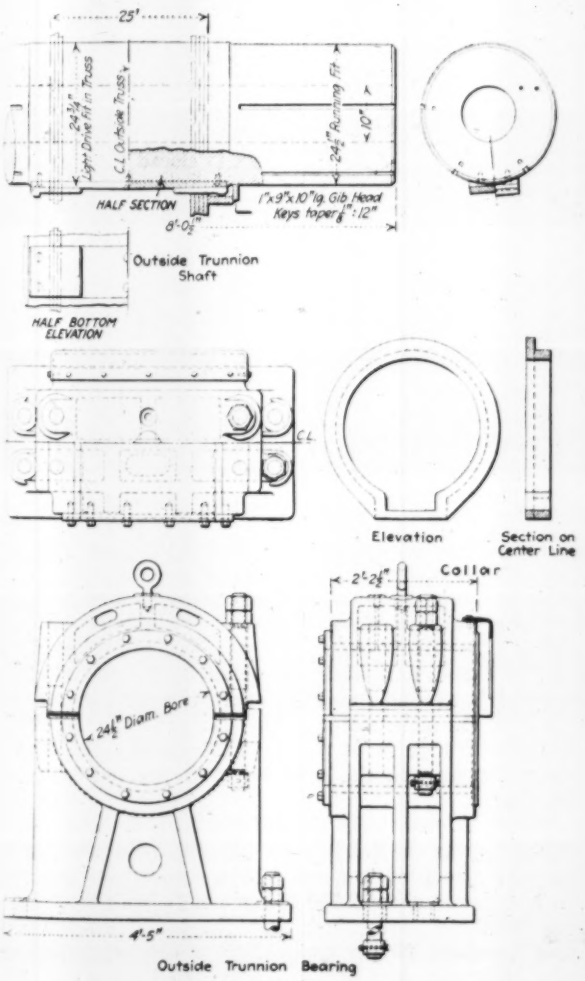


FIG. 5. TRUNNIONS FOR 6,700-TON BASCULE

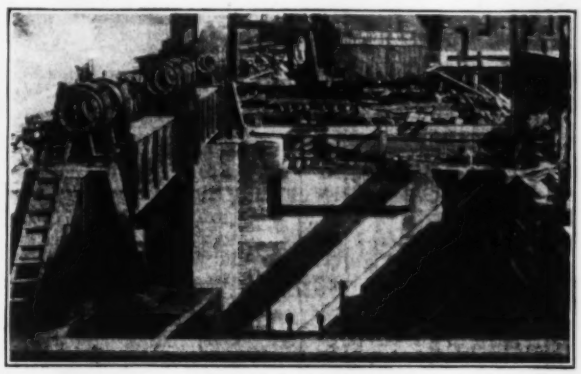


FIG. 6. HEAVY GIRDER CARRIES TRUNNIONS

Heel and End Locks—Heel locks to take the live-load reactions are four in number for each leaf, one lock in the plane of each truss (Fig. 9). These locks are operated through gear trains mounted on the anchor pier and connected with the toggle arm, which engages a casting on the rear girder of the counterweight box. The live load amounts to about 138,000 lb. per lock. What power should be provided for the locks was subject only to arbitrary assumption, but experience has shown that 10-hp. motors are satisfactory. The locks are also required to push the leaf into the final position, which places the heaviest duty on the motors.

Center locks (Fig. 10) are provided to insure that the two leaves of the bridge will deflect equally under live load, to prevent unevenness at the center break in floor. These are bolt locks placed in the bottom chord of each truss and are operated by 5 hp. motors so arranged that the two locks on each side can be operated independently. The machinery for operating the locks is placed below the lower-level floor, and the gearing is connected to rods which operate levers that force the bolts into place.

The locks were designed in accordance with the standard practice of the city of Chicago. They were proportioned for the greatest shear at the end of the arms, which can be definitely determined. The operating mechanism, however, was proportioned for the size of motor which experience has shown to be necessary to operate the bolts against resistances due to small differences in the alignment of the leaves at the guide castings. It has been the experience with Chicago bridges that locks of this type operate satisfactorily when properly adjusted, though there have been instances where these locks have not operated satisfactorily, but this has been chargeable to bad adjustment rather than to deficiency in strength.

Safety Devices—Exceptionally heavy traffic conditions and the large proportion of fast automobile traffic on the Michigan Ave. crossing necessitated special attention to provisions for safety in the operation of the bridge. For this reason a full intercommunicating signal system was installed, in addition to locks and gates, and all these devices were interlocked with each other and with the operating motors, in order to assure protection of traffic. The sequence of operation of signals, gates, flexible barriers (not yet installed), center locks, rear locks and main motors as determined by this interlocking system is as follows:

Assume that the bridge is in the closed position and carrying traffic. The center and rear locks are closed, the roadway and sidewalk gates are raised, the brakes

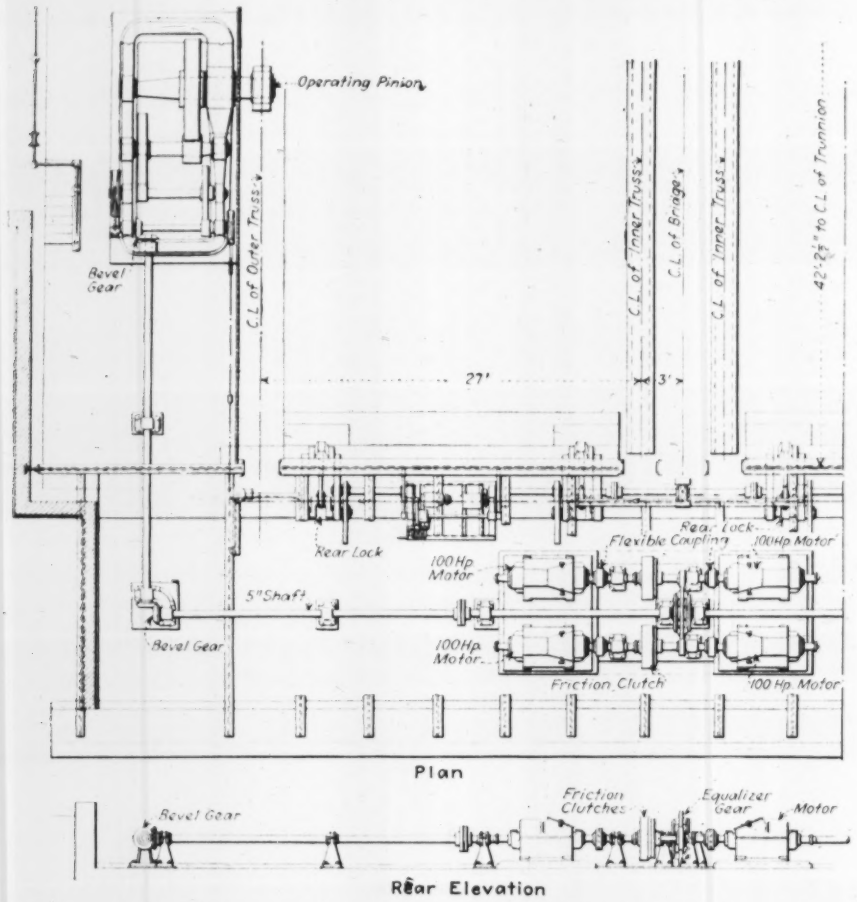


FIG. 7. LAYOUT OF OPERATING MACHINERY

may or may not be set, the magnetic feeder section switch is closed and current is available for the river signals, service and signal lights.

Following the practice as established upon the other city bridges, the operator having the control of the center lock (the north operator in this case) is the one to give the signal for starting the preparation of the bridge for raising, and he also gives the signal for the raising of the leaves. The operators and gatemen exchange signals for the purpose of calling each of the gatemen and the south operator to their posts. This is done by means of vibrating bells in the operator's houses and single stroke bells in the gatemen's and operators' houses. Upon receiving the return signals the north operator again signals as before, and the gatemen and operators each ring the large hand-operated bells and start the warning bells and flasher motors of warning signs by means of a snap switch located near the gate controllers. When these switches are closed current is available for the operation of the gates closing that section of the roadway at which the signals are displayed.

The roadway gates against traffic approaching the bridge are stopped when they reach the fully lowered position, and at the same time they automatically close switches in the gate posts and current is available for the operation of the flexible barrier at that section of the roadway closed by the gates. The barrier is then lowered, a limit switch cutting off the current and applying a brake when it is down. The sidewalk gates are now lowered. When traffic has cleared the bridge the exit gates and barriers are operated in the same sequence. When all the barriers are down the interlocking switches at each barrier are closed automatically and the first section of the interlocking is completed.

The centerlocks may be operated at any time in the opening, the object of this being to permit of the opening of the center locks by the operator while waiting for the traffic to clear. In closing, however, the center locks cannot be closed until the rear locks are closed. The operation of the center locks is controlled by a master controller and the necessary magnet switches for accelerating and reversing; limit switches cut off the current and brakes are automatically applied when the limit of travel is reached in either direction. When the center locks are fully opened an interlocking contact is closed and the rear locks on the north and south sides may be operated independently.

The operation of the rear locks is controlled in the same way as that of the center locks. When they are fully opened current is available for the operation of the main motors on their respective sides, provided, however, that the clutch and throwover switches are in proper relation for the operation of the two motors for which the switches and clutches are presumed to be set. This arrangement is such that should the clutch on the motor shaft be left open and the throwover switch closed, for the operation of any particular pair of motors, or should the clutch be closed and the throwover switches be left open for the same pair of motors, the control circuit would be open and the movement of the main motor master controller handle would not be productive of any results, as the magnet switches could not be closed owing to the lack of control current.

The clutch and switches being in proper relation current is available and the operator pulls the reverse lever on the main motor master controller in the direction the bridge is to move. This unlocks the power drum handle and the operator may proceed to raise the leaf.

Traffic Figures—On the old Rush St. Bridge, which formerly was the link in the Michigan Ave. route, traffic in 1917 amounted to about 17,000 automobiles per day, in addition to about 2,500 teams and 10,000 pedestrians. In the three years since then the traffic undoubtedly has increased 25 per cent. Before the completion of the Michigan Ave bridge 50 per cent of all of the automobile traffic from the north side to the loop took

the Rush St. bridge, the remainder being distributed over the north-south crossings. Much of the latter traffic now goes to the Michigan Ave. bridge, and its total automobile traffic is approximately 30,000 per day. The lower level of the bridge, not yet opened to team traffic, accommodating two lines of trucks in each direction, probably will carry about 6,000 teams per day.

Weights and Stresses—The weight of the Michigan Ave. bridge, both leaves included, is about 13,400,000 lb., there being an average load on each trunnion of 1,675,000 lb. Thus the new bridge is the heaviest in Chicago, and probably it is heavier than any other double-leaf double-deck bridge of its kind in the world. The weight of the new Wells St. bridge, which will be its nearest competitor in Chicago, will be 9,600,000 lb. for both leaves, and this bridge will carry an elevated railway on the upper deck. The single-leaf double-deck bridge of the Canadian Pacific Ry. over the Kaministiquia River at Fort William, Ont., weighs 9,800,000 lb. It has a double-track railway on the lower deck and a 29-ft. roadway on the upper deck.

In determining the stresses for the truss chords of

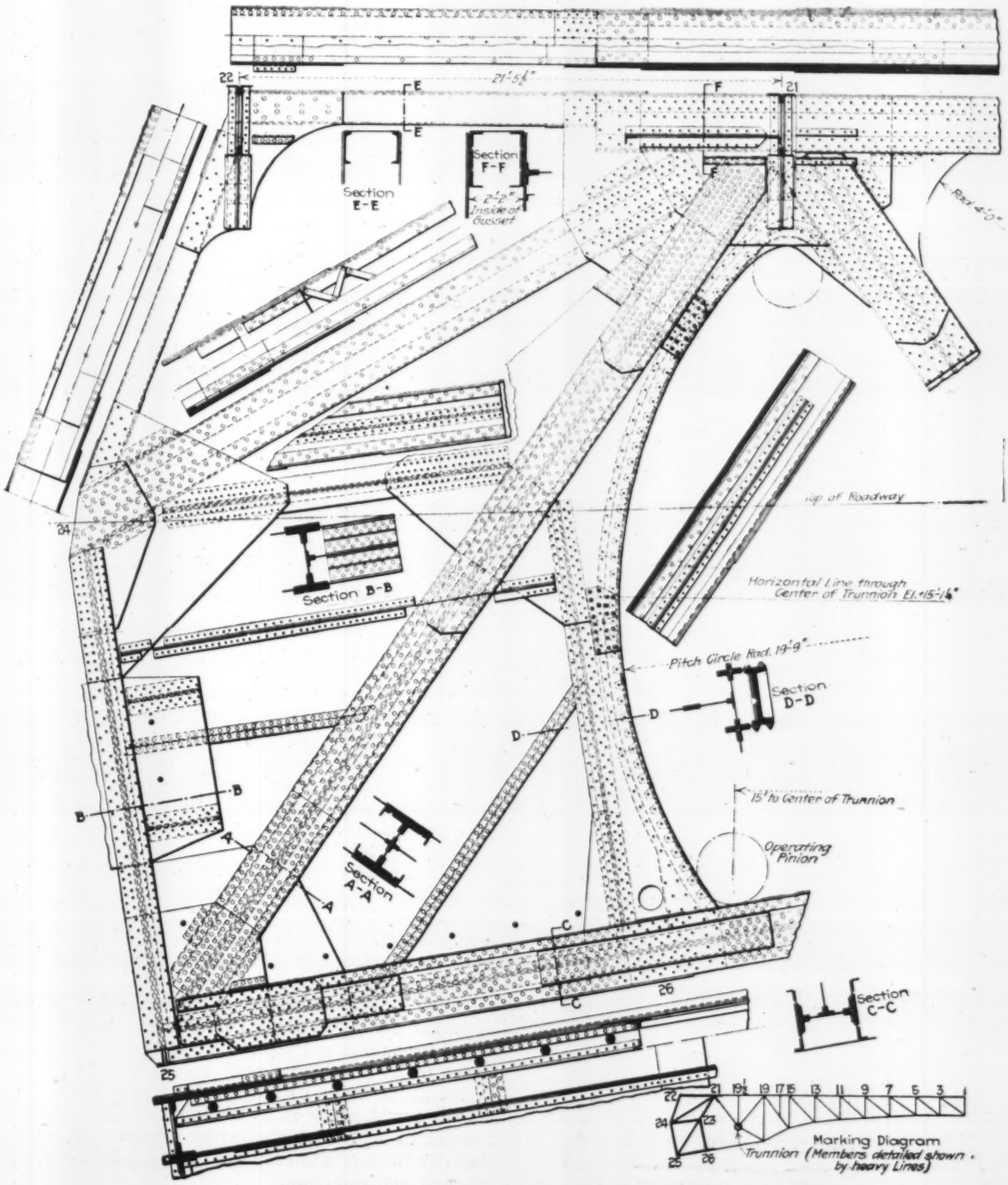


FIG. 8. HEEL OF DOUBLE-DECK TRUSS, WITH OPERATING RACK

the Michigan Ave. bridge the live load assumed was 100 lb. per square foot over roadways and sidewalks for the upper deck, and for the lower deck 2,000 lb. per lineal foot of street-car track distributed over a 10-ft. width, and 100 lb. per square foot over the remaining area, plus the actual dead load of the structure. For the design of the floor beams and stringers of the upper deck, and that part of the lower deck not occupied by street cars, the assumption was a live load of 24,000 lb. on two axles spaced 10 ft., and 100 lb. per square foot over the area not occupied by this load, plus the actual dead load. The street car assumed was a 50-ft. 50-ton car. Impact was added in all cases, determined by the formula

$$I = S \frac{100}{NL + 300}$$

in which S = maximum live load stress, L = length of load producing maximum, N = % of the loaded width of roadway and sidewalks. For all cases of reversal of stress in members 50 per cent of the smaller stress was added to either stress to obtain the designing stress. The maximum stress, 2,692,000 lb. tension, occurs in the outside truss members leading from the top chord to the counterweight box, just to the rear of the trunnion.

The counterweight is composed partly of concrete weighing 145 lb. per cu.ft. and partly of a composite

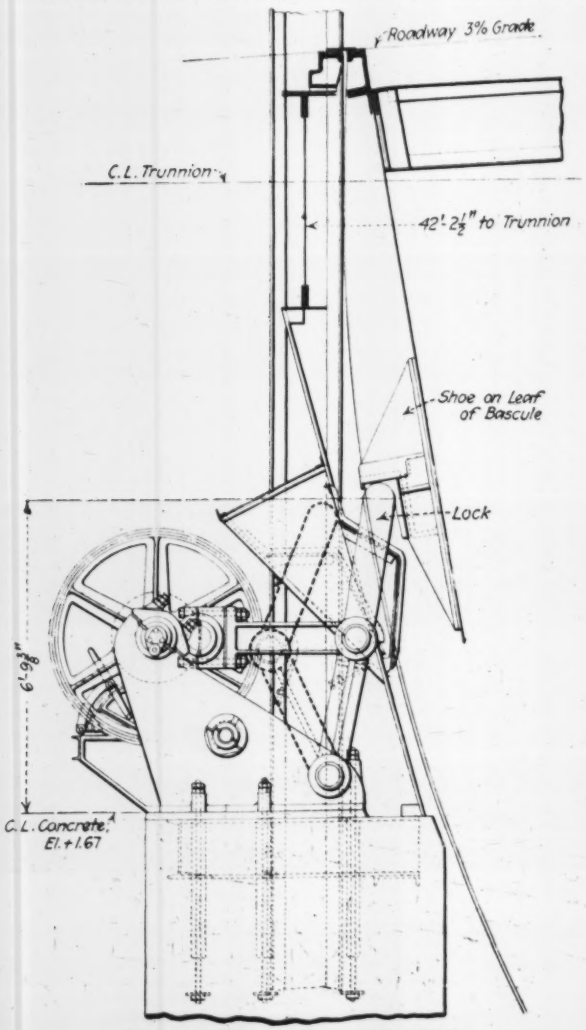


FIG. 9. HEEL LOCK OF BASCULE

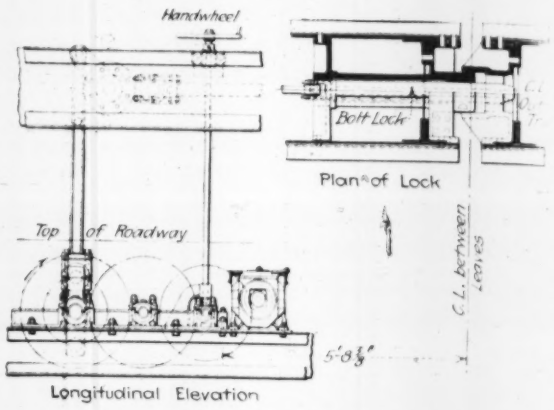


FIG. 10. CENTER LOCK OF BASCULE

concrete formed of concrete and rivet punchings weighing about 300 lbs. per cu.ft. The counterweight for each leaf contains 930 tons of 145-lb. concrete and 665 tons of 300-lb. composite concrete, a total of 1,595 tons per leaf.

The Michigan Ave. improvement, of which this bascule bridge is the principal feature, is one of the main items in the "Chicago Plan," supported actively by the City Plan Commission. The improvement was developed largely through the efforts of Michael J. Faherty, president of the Board of Local Improvements. The plans and specifications for the entire improvement, including the bridge, were prepared in the Bridge Designing Section of the Bureau of Engineering; Hugh E. Young, then engineer in charge of bridge design; Thomas G. Pihlfeldt, then engineer of bridges; P. S. Combs, city engineer; C. D. Hill, engineer of the Board of Local Improvements. William A. Mulcahy was chief engineer in charge of construction. The Great Lakes Dredge & Dock Co. was the general contractor for the work and the structural steel was fabricated by the American Bridge Co.

British Imperial Forest Policy

At the recent British Empire Forestry Conference in London, according to *U. S. Commerce Reports*, it was emphasized that the foundation of a stable forest policy for the Empire must be the collection, co-ordination and dissemination of facts as to the existing state of the forests and the current and prospective demands on them. To this end it was considered of the first importance that a systematic survey be undertaken in each part of the Empire which would serve not only as the basis of the forest policy in that part, but also provide a means for reviewing the forestry position of the Empire as a whole. The destruction of forests in the United Kingdom during the war for military purposes and the dependence upon overseas supplies have led to extensive reafforestation plans and given stimulus to governmental action toward securing a scientific forest policy based on the economic principles of annual cutting of surplus timber as a crop and provision for automatic reproduction, as well as the afforestation of large unused areas. It was urged that each of the governments of the Empire should lay down a definite forest policy to be administered by a properly constituted and adequate forest service. A central Forestry Bureau in London was recommended for study, research and reference.

Notes from Foreign Fields

GENERAL IMPRESSIONS OF EUROPE

BY E. J. MEHREN
Editor of *Engineering News-Record*

RETURNING to America I have been urged by my associates to write at once a summary of my impressions—such a summary, as they put it, as one would give in a ten-minute talk to a group of friends. Complying with the request, this contribution to "Notes from Foreign Fields" is published in advance of its regular order.

The briefest possible summary of my impressions is expressed in one word—*discouraging*. The situation is discouraging industrially and politically.

In England, France and Germany orders are falling off and an industrial crisis appears to be approaching. In England a serious strike is threatened and labor conditions generally are serious. There is war between Russia and Poland, and between Greece and Turkey; the English have military operations on their hands in the Near East; France and England are not in agreement on the treatment of Germany and have been dangerously near a split on the Russo-Polish question; France is playing politics with Belgium, with Holland's control of the mouth of the Scheldt as one of the factors of the game; England has a mean and serious problem on its hands in Ireland.

All in all, the outlook, at least to an American, is very discouraging. One American manufacturer who knows Europe intimately remarked to me that "Europe is no farther ahead today than it was at the signing of the Armistice." That is probably an exaggeration, but he meant to convey the impression that there was not a satisfactory solution of the great political and economical questions that existed on Nov. 11, 1918.

INDUSTRIAL CONDITIONS

Industrially, western Europe is slowing up. Many German factories, as recorded in the article which follows are working half time. Buying has dropped off sharply in France and Great Britain, and English business men are looking for a depression. Competent financial students, fellow passengers on the homeward voyage, reported that their conferences with European bankers had checked the views that I had gathered.

In England, labor difficulties are looked for. Just before sailing on Aug. 14 the mutterings began in the coal trade. Since then the situation has crystallized and, as I write, the strike vote is being taken. An appreciation of the power which Labor believes it has can be gathered from the fact that at the height of the Russo-Polish crisis a Committee of Action, representing the labor organizations called upon Lloyd George to serve notice that if England should decide to go to war in support of Poland the workers would refuse to move the munitions.

Political Situation—Politically, the situation in Europe is equally disturbing. The Russo-Polish situation is known to all of us. Unfortunately, it has tended to widen the rift which has been developing between England and France. The latter's unexpected recognition of Wrangel came while I was in England. To say that it caused dismay is putting it mildly. A more excitable people than the English would have indulged in rabid talk. Instead, all English views were focused on reaching an immediate understanding and preventing the breach from widening.

The disagreement between England and France as to Germany has been increasingly emphasized in the various conferences following the conclusion of the Versailles Treaty. Only dire necessity, it seems, is holding them together, and I cannot help feeling that they will not for many years go hand in hand. I do not mean that there will be an open breach, but that England's policy will so favor Germany and be so in contrast with the French that there will be estrangement between them. The view was expressed to me by the keenest man I met in England that, fundamentally, there is more reason for sympathy between England and Germany than between England and France. England and Germany are both industrial nations, with strong commercial instincts, and a tendency to take a similar view of international questions. Temperamentally, also, they are much alike. On the contrary England and France, are entirely unlike each other temperamentally and in their industrial and commercial aptitudes and outlook.

In this connection an interesting story was told me by an Austrian. In 1913 he attended in London a luncheon given by a member of Parliament and sat beside a distinguished English statesman, subsequently Chancellor of the Exchequer. The latter asked the Austrian whether he thought there was danger of war between England and Germany. The Austrian's reply was that he heard no such talk in Berlin, where he then resided, and that he considered a war impossible. The statesman's prophetic reply was that he believed that England and Germany were destined to be fast friends, but before that took place there might have to be a war.

Certain it is at the present time English business men are looking very favorably upon trade relations with Germany and, in fact, are in Germany in large numbers engaging in business negotiations.

France, unfortunately, is being alienated from the strong nations of Europe. I heard enough in England to realize that keenly. Germany's attitude toward France is well known—and natural. I was not in Italy, but men who were there told me that the attitude toward France was not a sympathetic one. In Holland I heard sharp criticism of France, two men making almost identical remarks to the effect that France's victory had intoxicated her.

BOLSHEVISM

Regarding a spread of Bolshevism I found that there is little fear entertained in England or France that their countries will succumb to it. In England the prediction, so often made in the last two years, that there would come a Labor government is still repeated. It is felt, though, that responsibility would cause the labor leaders to modify their radical program. The sound sense of the British people is relied on to save the country from excesses.

France believes that it has had its test with Bolshevism and come off victorious. In fact, its unwill-

ingness to recognize Russia is no longer put on the ground of fear of Bolshevism, but on the ground that it should not recognize a government that will not assume the former Russian debt to France.

In the Central Powers, anything may happen. That is always true when people are cold, hungry, and without hope. American observers whom I met on the trip home had the same feeling that I have with reference to the Central Powers. One of them, a journalist who has represented the New York *Times* in Europe for many years, closed a statement in which he expressed his confidence in the German promise to live up to their obligations with reference to the delivery of coal, with the words, "I am as positive about it as one can be about anything in Europe today." Another American, general manager of an American enterprise having four plants in Europe, said briefly, "No one can tell what is going to happen in Europe." He expects a crisis throughout western and central Europe, accompanied by unemployment and suffering. In the past such crises have passed without revolutionary endeavor. Today, in the Central Powers at least, the danger is that there may be revolution.

The one bright feature of the whole situation is that the principal food-raising countries of Europe have excellent crops this year. That is true of France, Germany, Austria, and Czecho-Slovakia. The food situation should be better this winter than it has been for many years, but, even so, the amount available will not be sufficient in the Central Powers to carry the people over to the next harvest. Means must be found to supply them from the United States and probably Argentina, even with the exchange so badly against them.

The League of Nations

An American is naturally curious to know how the people of Europe feel with reference to our non-participation in the League of Nations. Naturally there is deep disappointment. The League was President Wilson's creation, and the people of Europe believed firmly that he had plenipotentiary powers. In a nice way they accuse us of "welching" on our contract. Apparently, though, they are but little interested in the military feature of the covenant. They are all tired of war. They do believe, however, that if we had sat in on the conferences that have followed the completion of the Treaty the United States would have taken hold of the credit situation and either directly or by government approval and encouragement of consortiums of bankers helped to put the Continent on its feet in a practical way.

As one travels around he cannot help but feel apologetic for the American position, even though he may sympathize to the utmost with the action of those senators who prevented approval of the covenant unchanged, as the President wanted. One American put it well when he said that we had created Poland, that we had helped to put France in a position where she could, single-handed and without reference to any other power, invade the Ruhr, and then had washed our hands of the whole situation. Certainly the political alignment in Europe today is largely of our own and President Wilson's making. Yet, having created the situation, we have shouldered none of its responsibilities. What form our participation should have taken and should still take seems to be a matter of indifference to the European. If we come in and help, we can name our own terms.

While one feels apologetic for our position he cannot escape the thought that we are fortunate to be free of "entangling alliances." We may have moral obligations there for the time being, but no one who sees for a period of three and a half months the interplay of politics in Central and Western Europe will want to put us in a position where our hands are tied or where we will be compelled to act.

England's Hopefulness

Before sailing for home I recrossed the Channel and spent eight days in England, taking occasion to see acquaintances and get the English view of the Continental situation. I had left Holland feeling, as I have here set down, quite discouraged. To my surprise I found the Englishman very calm about the whole situation. He sees the serious side of it, but is confident that much progress has been made and that the present situation, while much confused, is becoming better week by week. That comes, no doubt, not merely from the naturally calm temperament of the Englishman, but from his long interest in and study of international affairs. My admiration for the English was immeasurably heightened by their wonderful attitude. One American said to me that the crux of the whole situation in Europe was the confidence which investors would have in the promise of the German people to make good on the indemnity bonds that may be issued, to meet their obligations. There may be much truth in that, but if I had to name the factor through which the salvation of Europe is most likely to be worked out I would unhesitatingly name the British people. They have the capacity and experience to handle the situation, while their position adjacent to the Continent forces them to take the matter in hand lest a break up result in alignments unfavorable to them.

Coming home after an absence of four months and getting into the swing and the hum of American life, finding that our costs are only double pre-war costs, as against threefold to tenfold increases in Europe; seeing our resources, as represented in our broad fields, sensing the strength of our industrial life I cannot but feel that we fail to appreciate how much better off we are than the people of Europe. One German said to me in Berlin that we had got more than we deserved. He made the remark half in fun, but I cannot help wondering whether there is not some truth in it. We are lavish of our natural resources. We waste to an appalling extent. We regard as trifles the economies that loom up importantly in Europe. Natural resources considered, our development of them is extremely inefficient. We are living in a gold mine, yet we quarrel and are dissatisfied. We live on the fat of a rich land, and earn our daily bread by loafing half the time, or what is the same working at half pace.

Could our people be brought to an appreciation of the difference in conditions between Europe and America, I am sure that the unrest here would disappear and that enthusiasm and loyalty and an effort to solve our problems without strife would replace the present attitude. To get a deep appreciation of what America is, what its possibilities are, a trip to Europe—and a trip right now—to learn by observing the contrast, can be heartily recommended.

New York, Sept. 2.

General Conditions in Germany

The engineering visitor to England, France or Switzerland naturally devotes his time to a study of the problems of his special field. No so in Germany. There the fundamental social conditions so transcend all special problems that one forgets he is a specialist and loses himself in any inquiry into the general situation.

As a whole, the conditions here are discouraging. The people of the cities, generally, are under-nourished, unhappy, and without hope as to the future. They have suffered grievously. What is past they would be glad to forget, but, unfortunately, the memory of what they have endured is always with them because of the continuance of unsatisfactory conditions and the prospect, they believe, of privation for years to come. They have been put in this frame of mind mainly by insufficiency of food—in both quantity and quality. Conditions have improved materially since the last year of the war, and even since 1919, but the foodcard system still persists and the rations supplied against the cards are insufficient in quantity, while the quality is extremely poor. The quantities called for by the food cards, per week, are as follows:—

THE CARLSPLATZ, A "BUSY" SQUARE IN MUNICH
Taken at 4 p.m. on July 16, a weekday. Note the absence of traffic.

Bread	1¼ kg.	(2.75 lb.)
Flour	340 g.	(12 oz.)
Sugar	170 g.	(6 oz.)
Butter	60 g.	(1⅞ oz.)
Fat	100 g.	(3½ oz.)
Meat	200 g.	(7 oz.)
1 Egg		

Only children under two and the sick receive milk.

The quality of food and, with the obvious exception of the eggs and sugar, is far below that found in the very poorest quarters of any city I have seen in Europe or America. The bread is made of barley flour with a 25 per cent admixture of rye and some maize. It is heavy, coarse, and unpalatable.

To test the quality of food I ate on several occasions in restaurants of the average class. The prices were higher than can be afforded by people even in the higher clerical positions yet in one restaurant the food was uneatable, the stew made with rancid meat and the fruit desert sour. Only the plain cooked vegetables were acceptable. In the other restaurants the food was tasteless and of poor quality, but eatable.

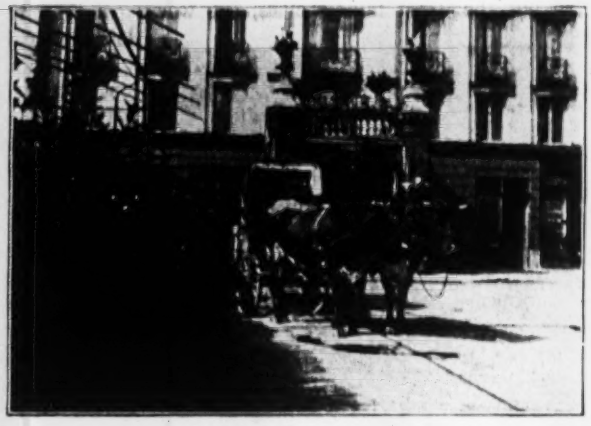
Green vegetables and dried peas and beans can be purchased in the open market but the prices are roughly ten times or more what they were before the war. It is possible to buy meat of fairly good quality, chickens, eggs, and occasionally butter and fat, from dealers who buy secretly and unlawfully from the farmers. Repeated efforts have been made to stop this traffic and to turn these supplies into the channels of official rationing, but despite repeated convictions and punishment the farmers continued to hide their products and sell them at high profit to secret dealers. In fact, it is only by buying from illegal sources that it is possible to maintain oneself in even fair physical condition, but only those who have profited by the war or whose wages have gone up in proportion to the cost of living can do so. Skilled laborers *who have regular employment* can do so but the great middle class, far worse off than the laborers, cannot. The food conditions show themselves in the appearance of the people. Even in Berlin, which presents a much more hopeful picture than Munich, the poorer and middle-class districts are filled with under-nourished people, and, more's the pity, with under-nourished children. The children have a pallor and leanness that do not go with healthy childhood, while often one finds cases of under-nourished, aged heads on little emaciated bodies—that are heart rending. What is true of the poorer quarters of Berlin regarding under-nourishment is true of *every part* of Munich.

Yet it is easy to be deceived regarding food conditions. If one confines his observations to Berlin, and in Berlin to the business district and the wealthy West-end, he will, probably, report that food conditions are good. In fact, the very first American I met after a week's stay here remarked, immediately after the exchange of greetings, that he did not find food conditions "so bad." On close questioning he and his wife admitted that they were staying at the Adlon Hotel and had eaten only there. They had had the best of meat, excellent fowl, white bread, delicious butter—everything they wanted. Undoubtedly, they will go back to their small manufacturing town in Pennsylvania and declare that reports regarding food conditions are exaggerated. They probably paid 200 marks a day for their room, if without a bath, and 300 or 350 marks if with a bath, while for the two of them each luncheon and dinner cost not less than 100 marks, which, referred to the purchasing value of the mark before the war, means as much to a German as a $50 meal for two would to an American. I had the similar experience of getting whatsoever I wanted at from 40 to 50 marks per meal, but it is unnecessary to say that no German, except a war profiteer, can pay those prices.

In general, when present-day prices are quoted, an

American can appreciate what they mean to a German if he remembers that before the war a German could buy as much for 2 marks as we could for $1. In other words, if a German pays 50 marks for a meal the impression upon him, compared to pre-war purchasing power, is the same as that on Americans if we paid $25.

My own observations of food conditions, based on inquiries from housewives, excursions in the poorer quarters of Berlin, eating in average restaurants and living in a private family in Munich, are completely borne out by the fact that the American Relief Administration (under Herbert Hoover's direction) is not only continuing its food-supply work in Germany, but is making efforts to bring its work to the attention of all classes of Germans, so that they in turn can appeal to American relatives and friends to help them through the purchase and transmittal of food drafts. The American Quakers are continuing their food stations for undernourished children, while the British branch of the Salvation Army and the British "Save the Children Fund" Committee are continuing to supply milk rations to children. The German delegation at Spa reported a great increase in the death of children under 5, and an 11.4-per cent increase in tuberculosis, comparing 1919 with 1913. One may be tempted to disparage those German statistics, but he cannot brush aside the evidence afforded by the continuance of the relief measures of English and American organizations.



IN A MUNICH STREET

Clothing and Fuel—But food shortage is not all that depresses the Germans. Coal shortage, almost since the beginning of the war, has kept them in a freezing condition the greater part of the winter, while clothing is prohibitive in price. For private families the coal allowance is 100 kg. (220 lb.) per month, summer and winter. In winter only one room is heated. In apartment houses having steam heat, where the cooking is done by gas, conditions are even worse, since the central heating plants are shut down. There are no smoke stacks for the installation of coal-burning stoves, and the gas ration is sufficient for cooking and lighting only.

While food prices are about ten times what they were before the war, clothing and shoes are from twenty to thirty times as expensive. Before the war a good suit of men's clothing could be bought for 70 marks; today a suit of decent quality, not up to pre-war quality, costs 1,600 marks. To a German that means the same as if a $85 suit for us had increased in price to $800. Prices of clothing for women and children has increased in the same proportion.

Appearance of the Cities—Industrially, the country is very quiet. In the north there was an industrial revival after the Armistice, but on account of rising prices both foreign and domestic buying dropped off sharply about three months ago, and the industries now are working only three days a week. South Germany had no industrial revival, and the conditions there are accordingly worse. I saw large plants shut up that had not turned a wheel since the close of the war.

The cities naturally show the effects of these conditions. Munich is a dead city. It has less life than one of our 50,000-population towns. So striking is the lack of vehicular traffic that I took a census for an hour in the *Marienplatz*, the broad street or "square" in front of the *Ratshaus*. The avenue is 150 ft. wide and has four traffic ways, two in either direction, and four street-railway tracks. Yet on this broad street I was able with ease to take a vehicular-traffic census by myself. The count, kept on the back of a visiting card, for the hour between 9:55 and 10:55 a.m. on July 16, was as follows:

Horse-drawn passenger vehicles	4
Horse-drawn commercial vehicles	12
Passenger automobiles	19
Motor trucks*	12
Hand-carts	30
Street cars†	42

* The motor-trucks included five post-office vans.

† Most of the street-cars had two trailers and the remainder one trailer each.

Note—From a taxi-cab stand at this point only two auto taxi-cabs were hired in the hour, and only five horse-drawn taxi-cabs.

It should be noted that before the war the use of hand-carts was almost unknown in Munich, while the horse-drawn taxi-cab had disappeared from the streets.

Unless an engineer is concerned with street or highway design he gives but little attention to traffic figures. Those who wish to get a correct idea of the lack of traffic in Munich would do well to stand on a busy corner in any of our cities of 50,000 or more people and for 10 minutes make a count of the vehicular traffic, and then compare it with one-sixth of the Munich figures. I wager that even in a town of 50,000 they will find the traffic heavier than in the *Marienplatz*, the business center of a city of 600,000 people. Some photographs, which are thoroughly representative, and not taken at an interval more quiet than usual, show the almost complete absence of traffic in the business center.

This lack of traffic agrees with the attitude of pedestrians. They are an unhappy people, downcast, care-worn. One and all, they seem to be carrying a burden. The whole atmosphere is a listless one. The *Hofbrauhaus*, once the gathering place for the happiest and most contented throng in the whole of Europe, is nearly deserted. The little knots of people scattered through its great restaurants and halls are quiet and serious. That is true, also, of the other Munich restaurants, which, before the war, were famous throughout Europe for their good-natured companies.

Berlin presents a more encouraging picture. The vehicular traffic is not much heavier than in Munich, due to the present industrial stagnation, but the people are, on the whole, better nourished. In the business district they go along with some vigor, as if life were worth living.

This difference between the two cities probably has two causes. The Bavarian (Munich is the capital of Bavaria) is an artist, and, therefore, temperamental. The Prussian is practical, and more accustomed to overcoming difficulties. Second, there was no industrial revival in Bavaria, while northern Germany profited by fairly good industrial conditions during the latter part of last year and early this year. Earnings were, therefore, larger in Berlin than in Munich, and the difference is shown in the condition and attitude of the people.

Views As to the Future

The view that a nationalization of all wealth must certainly come in Germany, is quite widespread, those that so believe holding that it is the only means through which the workman will be made contented with his lot and apply himself. If the workers, it is argued, are brought to realize that nothing has value in Germany except labor, class prejudice will disappear and Germany will be able to develop an idealism through which she can get on her feet. These men pointed out that fortunes have now been reduced to the level of labor. A fortune of 300,000 marks was a large one before the war. At 4 per cent, the usual German return, the income is 12,000 marks, which now is the salary or wage of a first-class stenographer, an office worker, or a common laborer regularly employed. In other words, a man or woman with an inheritance of 300,000 marks is in the same position financially as a stenographer or laborer. The advantage of fortune, having been wiped out, the remaining step, it is argued, of putting all industries under the control of the government is not a long one.

Opposed to this view is the opinion of business men that the country is really farther today from general socialization than it was a year ago. Even the political leaders of a solialistic tendency have come to appreciate, so the business men say, that an incentive is necessary in the shape of freedom for initiative and opportunity for personal advancement in order to get the best from both laborer and brain worker. They maintain, too, that the political leaders have profited by the Russian debacle and are fearful of schemes that may further interfere with industrial organization.

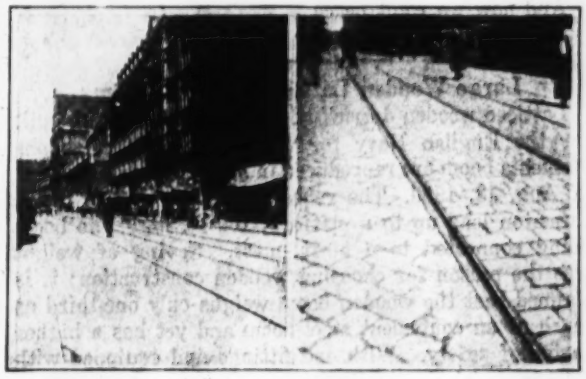
The attitude toward Russia is uniformly quite favorable, though the reasons given for alliance or friendly relations differ with various classes. The agitators hold that alliance with Russia would enable Germany to rebuild her military power, but the middle and educated classes see in friendly relations opportunity for commercial expansion. German brains could help to organize Russia's natural resources, while the growth and development of the country would create a tremendous market for German products. This favorable attitude is shared, apparently, by the present government, for it will be remembered that Dr. Simons, minister of foreign affairs, stated after the Spa conference that if Poland persisted in being a bulwark between Russia and Western Europe she would have a very hard time, but that her lot would be easy if she served as a bridge.

On one imminent question regarding the future, there is entire agreement—that the plebicite in Upper Silesia, where rich coal fields are located, is of vital importance to the future of Germany. Should Upper Silesia remain with Germany the latter will have the coal essential for, at least, industrial production. If Upper Silesia goes to Poland, German industry will be very seriously crippled. One engineer said solemnly, "Without Upper Silesia German industry is dead." For that reason the result of the September plebicite is being awaited with intense interest. Just now there is considerable optimism regarding the probable result, for it is not believed that Upper Silesia, in view of conditions in Poland, will cast her lot with that country.

Attitude Toward Foreigners

During the war there was great bitterness toward England. That feeling his disappeared and Englishmen are now in high favor, for the Germans feel that England is willing to give them an opportunity to get on their feet. Lloyd George's attitude in standing against the severe demands of France is deeply appreciated, while the English people, as individuals and through committees and societies are doing much to relieve the clothing and food distress.

Toward France there is much animosity. The French, so the Germans feel, desire to grind them down to the utmost—even to the extent of making it impossible for



ON THE STREETS OF MUNICH

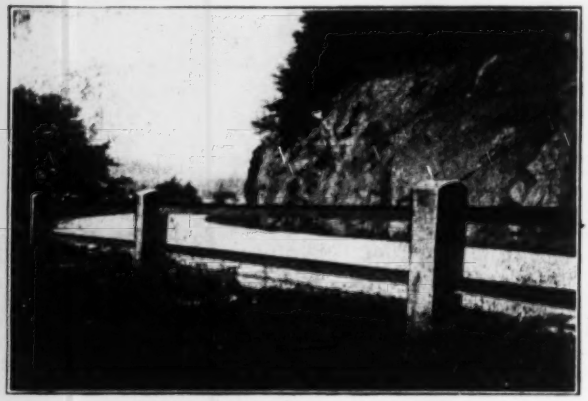
The left-hand view shows the absence of traffic; the other, granite block laid diagonally between track and footway.

Germany to pay the indemnity. All they ask, they reiterate, is the chance to work and pay their debts. They admit that they did not deliver the coal required by the treaty, but maintain that it was only through the sale of coal, to Switzerland and Holland for example, that they could get food.

Toward Americans, the attitude also is a friendly one, due not only to the extent to which the Hoover food drafts are being sent to Germany and to the work of the American Quakers in feeding German children, but also to the belief that had America signed the peace pact and become a member of the League of Nations, she could be counted upon to support Lloyd George rather than the French in the various conferences following the Versailles treaty.

Whether that view is correct it is not possible to say with certainty. My own feeling is that we in America will take the same position as the English: "The war is over. Let's give Germany a chance to get on her feet, merely taking care that she shall not again become a military menace."

As to the terms of the treaty I have heard little complaint. The word always is, "Give us a chance, give us credits in raw materials, let us keep enough coal, and we shall pay our debts." The paying of her debts is



GUARD RAIL ON KESSELBERG ROAD, A FAMOUS BAVARIAN HIGHWAY SOUTH OF MUNICH

synonymous with industrial rehabilitation, and for her rapid industrial rehabilitation the people of America should hope no less sincerely than the Germans.

Germany unsettled and disturbed will disturb not only the whole of Europe but the whole world.

And now we want peace.

Berlin, July 24.

Large Wooden Latticed Derrick Booms

Latticed wooden derrick booms 135 ft. long were built for the English Navy for war service. Photographs of such a boom are reproduced in *Engineering* (London) of Aug. 13, 1920. The required service was to lift a three-ton load up to a platform 100 ft. high, the boom being connected to a 50-ft. mast. Saving of weight was the reason for choosing wooden construction; it is claimed that the wooden boom weighs only one-third as much as an equivalent steel boom and yet has a higher factor of safety. With end fittings and equipped with a 21-in. hoist sheave it weighs only 6,000 lb.

Like many steel derrick booms, these wooden booms are of balloon-braced shape. In side elevation they taper to both lower and upper ends, but in plan only the upper end has taper, the ribs being kept parallel in the lower part for wide bearing on the hinge pin at the foot of the boom. The main material of the boom comprises four Oregon pine corner members or ribs, 4½ in. square at midlength, 3½ in. square at the top, and 4½ x 3½ in. at the foot of the boom, each glued up of nine boards. The ribs are spread by Oregon pine struts spaced so as to make the bracing panels about square, and are tied by crossed diagonals of stranded piano wire of ½-in. diameter in each panel. The spread of the ribs is about 6 ft. at midlength. The bracing struts are of greater diameter at the middle than at their ends; they are grooved on each of the four faces for the larger part of their length, making them cross-shape in section, presumably for lightness. The bracing diagonals connect to the ribs and struts by attachment to bolts set in "welded steel" connection boxes; the heads of the bolts form ratchets to permit of tightening the diagonals. To facilitate transportation each boom was built in two sections, joined at midlength of the boom by socket splices of steel in each rib held together by four tension bolts engaging lugs projecting from the main parts of the sockets. The end fittings of the boom also are of steel, the ribs being fixed in them by hardwood wedges.

LETTERS TO THE EDITOR

Credit Where Due

Sir—The statement of Mr. H. R. Green of Cedar Rapids that the editorial in the Cedar Rapids *Evening Gazette*, quoted by you on page 366 of your issue of Aug. 19, is "unsolicited publicity," gives the Cedar Rapids *Gazette* a little more credit for discernment of the modern capabilities of engineers than is due.

As a matter of fact, this editorial is copied from one which appeared in the Lexington (Ky.) *Leader* for May 1, 1920, and which was reprinted by the Publicity Service of the American Association of Engineers and mailed to a large number of newspapers throughout the United States. A number of other newspapers have copied the editorial or written new ones with it as a basis.

CEDRIC B. SMITH,
American Association of Engineers.

Effect of Chlorinated Water on Metals

Sir—Referring to the article in *Engineering News-Record*, July 15, 1920, p. 127, regarding the corrosion of metals by chlorinated water at Sacramento: This general subject caused us a little anxiety, as we are using Wallace & Tiernan's liquid chlorine apparatus, the diffuser being located in a well from which our Allis-Chalmers pumping engine takes suction. As we understand it, the method in use in Sacramento was similar to our method here. However, we made an examination of a brass valve immediately joining the suction and did not find any evidence of corrosion. We have been informed that the apparatus in use at Sacramento is not the Wallace & Tiernan type which we use in Terre Haute.

DOW R. GWINN,
President and Manager Terre Haute Water Co.
Terre Haute, Ind.

Twin Reinforced-Concrete Tracks for Highways Suggested

Sir—Full-width, hard-surface roadways for the country generally will be a long way off unless some genius of the near future makes some wonderful discoveries of new materials for construction, or finds more economical methods of handling available road materials. In the meantime the public must be satisfied with the cheaper roads, or submit to and pay for experimentation on substitutes for the fully paved country highway.

At the instance and on the suggestion of P. E. Bellamy of the State cement commission of the State of South Dakota, the writer has prepared the sketches, herewith presented, of a substitute for a paved roadway. Tentatively, this consists of four reinforced concrete track rails spaced at 4 ft. 8 in. on centers, each rail 12 in. wide and 7 in. thick on the sides, and grooved to a hyperbolic section so that the thickness at the center is 6½ in.

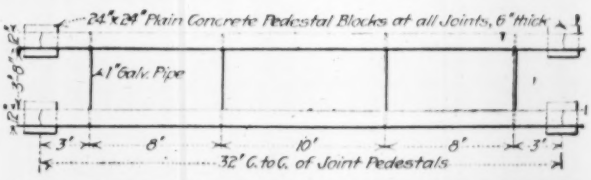


FIG. 1. PROPOSED METHOD OF LAYING TWIN TRACKS

The reinforcing consists of three longitudinal rods of ½-in. rounds, placed as shown. Expansion joints are provided for at intervals of 32 ft., and at these points base pedestals would be necessary. Perhaps plain concrete about 2 ft. square and 6 in. thick would be sufficient. Steel rods or shapes were at first proposed as ties for each pair of

track rails, but the writer has introduced 1-in. galvanized pipe.

In order to reduce the effect of frost action to a minimum the construction would presuppose thorough drainage of the road-bed. The rails would be recessed or imbedded for their full depth of 7 in. in the roadway grade in such a way that the rails would be on a slight crown, say about 3 in.

At section-line and other important crossings the rails would form part of a continuous pavement for about 100 ft., affording a touring car an opportunity to pass a slow-moving truck. An increase of rail width to 18 in. has been suggested to the writer, but it seems that this width would more seriously interfere with horse-drawn traffic. The proposed design is for a gross truck load of 4 tons with a maximum static wheel concentration of 3,000 lb. The material in the proposed section per linear foot of two complete tracks is:

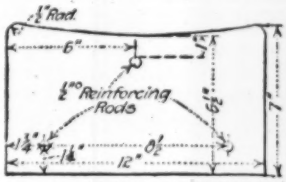


FIG. 2. CROSS SECTION OF CONCRETE RAIL

Concrete	2½ cu.ft.
Steel	10½ lb.

The writer would like to have *Engineering News-Record* lend its columns to its readers for discussions on the feasibility of the proposed construction as a substitute for a full reinforced concrete-paved roadway, and hopes information may be brought out on:

(a) Location of tracks, experimental or otherwise, of similar design;

(b) Age of tracks and kind of service;

(c) Composition of tracks and present condition;

(d) Kind of soil, whether loam, gumbo, sand, etc.

(e) Effect of frost action, if any;

(f) Designer or builder, if known, etc.

Suggestions or criticisms along the following lines are invited:

(g) Efficiency of the proposed reinforcement;

(h) Kind and position of rods proposed;

(i) Transverse reinforcement in rails, if any;

(j) Section and frequency of transverse tie rods that might be used with safety and economy;

(k) Cross section of groove, the proposed section being hyperbolic;

(l) Lengths and frequency of cross-overs having full-width pavements;

(m) Suggestions along lines of most likely economical construction;

(n) Suggestions along lines of financing one or more experimental sections in the State of South Dakota, etc., etc.

JOHN BERG,
Pierre, S. D. State Engineer, South Dakota.

What Makes This Vault Sweat?

Sir—Have you any information on how to prevent concrete underground from sweating? The conditions in this particular case are as follows:

A concrete vault 16 x 21 ft. by 7 ft. high inside was built, the top of the slab being even with the surface of the surrounding ground. A sun parlor 8 x 14 ft. rests on part of it. The work was completed July 31, 1920. The floor was poured first, 6 in. thick, with a keyway near the edge. The walls, 10-in. thick, were poured two days after. The top slab is 8-in. thick, reinforced with deformed bars on 7-in. centers. There was 2 ft. of light top soil under which was stiff red clay, fairly dry all the way. The mix was 1 : 2 : 4 with 2 lb. of Mintegne waterproofing being added to each bag of cement. The floor has remained damp since it was poured (July 24) and the walls started to sweat the day after the forms were removed. The roof appears to be dry where the forms have been removed. Two vent holes 3 x 3 in. were left in that part of the roof under the sunparlor. It is proposed to cover the balance of the roof slab with 18 in. of ground. An examination was made after a two days' rain, and while no ground water appeared to be coming in yet the walls were sweating very freely and the steel door was covered with beads of water.

JOHN H. FOWLES,
Milwaukee, Wis. Secretary, Sewerage Commission.

On What Are We Building Our Highways?

Sir—Much money is being expended annually in investigating and testing road surfacing materials. The Federal Government, many states, companies interested in the different materials, and private institutions have established large laboratories for such purpose. Yet we seldom find a laboratory making a study and test of the foundation soils.

Lately the Bureau of Public Roads has taken up this investigation in a small way and appreciates the great value of such an investigation and study, but the appropriation allotted this bureau for such an investigation is so small it will not permit of an extensive research.

Each spring many sections of our roads go to pieces, due to the foundation becoming saturated with moisture, frost action, seepage, capillary action, and other causes. It is useless to expect the road crust to carry all the load unsupported. A firm foundation for our highways is just as essential as it is for every other structure. The little study that has been made of the foundation has been devoted to draining wet places where the sub-base is constantly saturated by seepage water. Such places have been studied and in many cases remedied, but there has been very little, if any, study given to the bearing power of the different types of soils as a foundation. Especially at the period of the year when they are saturated with moisture, or the reverse when they are dry and contracted.

It is safe to say that we know less about the sub-foundation and its ability to sustain the metal surface under the moving load, than any other feature of road construction. There has never been any constructive effort made until recently to find out just what takes place, or to determine the ability of certain types of soils to withstand the impact and weight of a heavy moving load. I know of no element so important in road building that has been studied less, and of which so little is known, as the sub-foundation. The surface materials have been studied and experimented with at a great expense until they can be put togeher and give known results.

It recalls to the writer's mind the biblical phrase, "What doth it profit a man if he gain the whole world and lose his own soul." For what will it profit us if we develop the very highest type of surfacing if we lose it all by a weak and unknown foundation? The question of a stable, firm, and unyielding foundation must have our best thought. The physical and chemical composition of the sub-soils are so complicated that to solve this problem properly will require the very highest type of skill. Problems concerning materials, water, frost action, physical effects of heat, cold and moisture must be solved. The chemical action of acids, alkalies, and the many other different elements found in the soils leading to unknown fields must be found out. Not until this is done, and the bearing power of the sub-foundation can be ascertained by a simple test or brought to a known condition by treatment, will roadbuilding present no uncertain factors.

It is therefore most important that such investigations should be made and a solution found quickly, so that the roads in the future can be constructed to carry the maximum traffic over their entire length without injury.

This applies to the railroads and electric railways the same as it does to the highways, and all should join in a co-operative way in this investigation and find a solution. Congress should be requested to make a sufficient appropriation to the Bureau of Public Roads to establish a large research department so that such investigations can be speedily made and a practical solution found. By all working together a solution will soon be found, and much money annually saved.

H. G. SHIRLEY,
Washington, D. C. Federal Highway Council.

Highway Location and Design

Sir—W. G. Harger's articles in *Engineering News-Record*, July 15, p. 104; July 22, p. 171; and July 29, p. 200, on the economic study of highway location and design, come at a very appropriate time and will be of great assistance in solving a much discussed problem, providing others of equal railroad and highway experience will give us a résumé of their conclusions, either in future articles or in discussions of Mr. Harger's opinions and recommendations.

The rapidly increasing use of motor vehicles for short-haul freight and passenger transportation has outstripped the development of road construction. Maintenance costs of gravel and other similarly surfaced roads, under present conditions, have increased so rapidly that public officials have jumped at "hard surfacing" of the present roadbeds as the only practical solution of the problem.

Apparently there has been a slight reaction to this method and highway engineers are studying the situation from an economical standpoint. The same problems of location and design present themselves that have been studied and solved by railroad engineers for the last 25 years or more. (In passing, I wish to state that I have had none of this particularly valuable kind of experience.) Certain conditions differ, but the main factors and principles are the same.

This discussion refers only to roads requiring a hard surface, which confines us to the heavy traveled highways which are naturally, or are soon to become, parts of certain through routes, for which the name "trunk system" may be applied. Such a trunk system may be within state limits or be a part of the federal highway system.

Present traveled routes usually are improved original trails between local settlers extended to connect communities, often without any regard for grade or alignment as we use these terms today. These trails have been improved step by step as the traffic warranted and as the community developed and money became available.

The question now before the highway departments is: Shall these present traveled roads be hard surfaced or shall extensive relocations be made, and if so, to what extent? It seems logical to conclude that, under the present system and in the course of time, these roads gradually will be re-located as to grade and alignment until ultimately the most economical line is attained. The final result of these changes in location will approach a main line railroad location as a limit. In other words, a trunk highway will eventually be similar to a main line railroad but on a smaller scale.

What is needed to answer this question is the best judgment of the engineering profession as to how far we should go, in the interest of economy, toward the ideal location. The data as to the probable saving in operating costs by decreased distance, decreased rise and fall, certain maximum grades and degrees of curvature, given by Mr. Harger, are most valuable and the conclusions to which these figures bring us are evident.

However, after carefully deducing that radical improvement in location will result in great saving in the cost of operation of vehicles, Mr. Harger upsets the whole argument by reverting to past methods of highway design and attempts to excuse them by saying that he does not deem it advisable to make this saving for the public because the public is wasteful anyway and would not appreciate the saving but would spend it on ice cream and the movies. Is not this the type of economist that the periodicals have been blaming for everything from the H. C. L. to the present labor situation? Is not such an excuse poor logic on the part of a member of what is supposed to be a logical profession? Mr. Harger argues that since a little extra gasoline and a little extra time is of no consequence to a certain percentage of the traveling public, that the necessary expenditure to improve a location is not justified. Here again is evidence of the old highway methods retarding natural development. Why not study, discuss and decide the question and stand by the decision?

Is it true that "the location of a free public road with no direct revenue return can not be analyzed from the same point of view as a trunk line railroad"? It would seem to me that there is a fair comparison, for example: The public pays for the improvement, directly or indirectly, and certainly the public receives the benefit, directly and indirectly from any saving in operating costs which the improvement effects.

Mr. Harger accepts and quotes A. R. Hirst's values of a mile of distance saved—for example: For 100 vehicles per day the saving capitalized at 5 per cent is $73,000. Assuming that this figure is fair, is it economical or just to the public, traveling for business or pleasure, to follow present locations even through thickly settled and valuable land, where distance may be saved and gradients improved by relocation? Such relocation will undoubtely damage certain property, but this is not ordinarily a stumbling block where public service corporations are concerned, and such a capitalized value for this small number of vehicles will pay for all new rights of way required and any reasonable amount of damage which would be allowed after assessing benefits against the damages, together with the cost of the new construction. The relocation does not eliminate the existing road but will remove the through traffic, thereby reducing maintenance costs, and give the public as a whole the most economical route.

I may be in error, but it is my belief and that of many others, that in ten years' time, trunk highway locations, whether they are relocated as a whole or revised piece by piece, will resemble railroad locations closely. All will agree with me that, if this is true, relocation as a whole would be much less expensive. Certainly we should not neglect to study carefully the railroad comparison in order that we may profit by what railroad men have learned from costly experience.

Let us have the opinions of others.

EDWARD H. STELLE,
Assistant Engineer,
Minnesota State Highway Department.

Grand Marais, Minn.

[A copy of Mr. Stelle's letter was sent Mr. Harger, whose reply follows.—EDITOR.]

Sir—These articles on highway location were written with the intention of promoting discussion. I am indebted to Mr. Stelle for his courteous appreciation of the detail data given, and I am sure that any difference of opinion that we may have on general policy will add to the interest of the discussion. I hope that others will express their opinions.

We all would prefer to have scientifically located highways. A great many engineers believe that the time has come to make extensive relocations. I believe that minor relocations necessary to obtain reasonably good grades and alignment are justified at this time, but that extensive relocations must be gradually worked out except for a few exceptional cases, and that, practically, it will be easier to accomplish and fairer to the general public to do most of this work under reconstruction programs rather than to attempt extensive relocations at this time.

Large bond issues have the habit of disappearing without accomplishing as much as they are expected to accomplish, and any unusual feature of design (either of location or pavement) which raises the average cost per mile must be used with caution. The great need of most localities is a fairly complete road system usable the year round. Until this is accomplished extreme refinements have a doubtful value.

Probably 90 per cent of road traffic does not demand, nor would it be particularly benefited by, extreme refinements of location. On certain commercial hauling roads extensive relocations are probably desirable at once, provided the owners of trucks finance the extra cost of the improvement. But it seems very doubtful if it is good policy for the community at large to spend extremely large sums primarily for the benefit of this class of traffic which pays an entirely inadequate sum for the use of the highway. The so-called return to the community through reducing the hauling rates of a commercial truck haulage concern is not a very convincing argument to the taxpayer putting up the money for construction.

W. G. HARGER.

Rochester, N. Y.

HINTS FOR THE CONTRACTOR

Asphalt Cut by Device Made With Buggy Wheel

By W. F. Reichardt

Consulting Municipal Engineer, Watertown, Wisconsin

ALL contractors who have had occasion to use an asphalt filler on pavements have no doubt experienced much difficulty melting the asphalt, and from experience have learned that the smaller the size of the pieces of asphalt placed in the kettle the more readily does it melt. During cold weather asphalt can be cut with an axe, but as most of our paving is done in warm weather we find that at times when the asphalt is soft it is wellnigh impossible to cut it with an axe or any other sharp instrument.

WIRE AND BUGGY WHEEL MAKE ASPHALT CUTTER

The accompanying cut shows what a contractor did at Bayfield, Wis. By this simple device two men cut more asphalt in an hour than they could have otherwise cut in a day. The machine is constructed of two 4 x 4-in. pieces to which is attached an upright, supporting an ordinary buggy wheel. A heavy wire is fastened to the upright at one end and onto the hub of the wheel at the other. The barrel of asphalt is placed in the loop of the wire and when this wire is wound around the hub of the wheel and the wheel is turned, the wire cuts the asphalt. By this method the asphalt may be cut into any size desired.

Breaking Up Cement Gravel With Dynamite

By F. W. Wilson

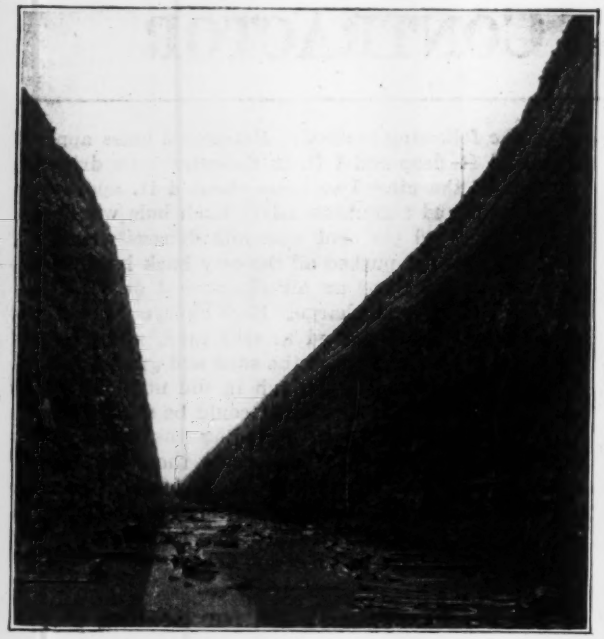
SUCCESSFUL use of 40 per cent ammonia dynamite in breaking up cement gravel for use in road fills was a feature of a road job recently carried on at Chittenango, Madison County, N. Y. The sand and gravel in the pit being worked were cemented together, making it very difficult to break it up with picks. Holes had been drilled with a well drill and also with a steam drill. These holes had been loaded with dynamite and shot, but the shock of the explosion had been absorbed by the many small air spaces in the cemented gravel and sand and little material had been loosened.

The cemented sand and gravel was successfully broken up by the following method: Horizontal holes approximately 4½ ft. deep and 1 ft. in diameter were drilled in the face of the pit. Two holes about 4 ft. apart were loaded and fired simultaneously. Each hole was loaded with 3 lb. of 40 per cent ammonia dynamite, and the explosive was not pushed all the way back into the end of the bore holes but an air chamber 4 or 5 in. long was left back of each charge. Each charge was entirely surrounded by and packed in stiff mud, affording the necessary resistance, which the sand and gravel, because of the large air spaces through it, did not. The blast loosened the material so that it could be shoveled without picking and the cost, including the price of the explosives was less by considerable than the time it would have taken laborers to pick it loose. The sand and gravel were so thoroughly cemented that when drilling was first done it took three men half a day to put down a 12-ft. hole, using a steam drill.

Movable Platform Used for Scaling Rock

AT THE lower end of the Queenston-Chippawa Canal around Niagara Falls, which is the feed line for the new development now under construction by the Hydro-electric Power Commission of Ontario, the cut is for a distance of about two miles through the Niagara limestone formation. It is here 48 ft. wide and of maximum depth of nearly 60 ft. The upper 10 ft. of the sides was channeled but below that the rock was close-drilled and the spoil removed by the big electrically operated steam-shovels used on all the canal work. The final section will be lined on the bottom and for 30 ft. up the sides with concrete and in preparation for this lining the rough cut sides are now being

SCALING PLATFORM IN NIAGARA CANAL CUT



SCALED SECTION—48 FT. WIDE, 52 FT. DEEP

scaled from a special trestle or platform which moves through the cut on trucks.

One of the views shows the platform in action. It is a simple wood frame with trucks for movement on sectionalized track and with suspended platforms on each side from which the scaling is done by men with picks. These platforms hang by wire cables from sheaves on top of the frame and are counterweighted for easy movement up and down. Plumb-bobs are hung from the top of the trestle on the line of the

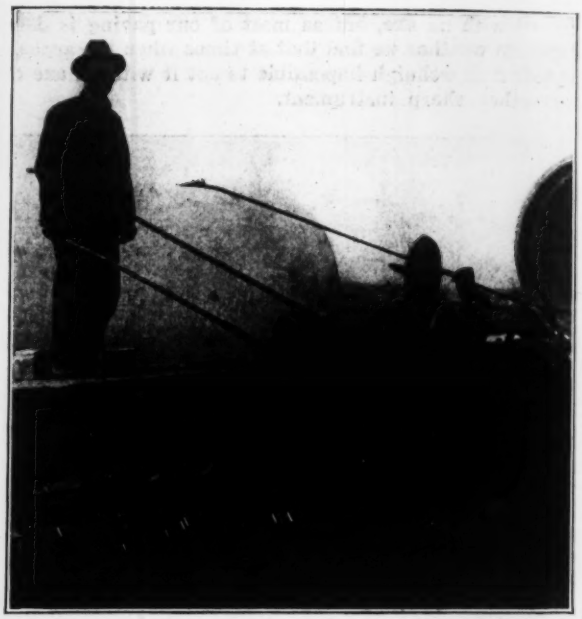
SCALING CREW AT WORK ON FACE OF WALL

clean cut and projecting pieces of rock are scaled off.

In order to hand the concrete lining to the rock face, dowels of old steel rods are grouted into the side of the cut at frequent intervals, either in single ⅝-in. rods or double ½-in. rods. The holes are drilled in about 2 ft. and the dowels bent over so as to hold the concrete facing.

Rolling Hitch for Unloading Pipe

FOR unloading 54-in. reinforced-concrete pipe from railway cars for the new conduit of the Denver water-works a portable rolling hitch has been devised. The hitch, an adaptation of a method used for loading and unloading logs in lumber camps, consists of a 4 × 4-in. stick, the ends of which are built up into 6-in. iron-bound cylinders. As shown in the view, the hitch is held by a heavy bow-shaped steel strap with a hook on each end, one to take the cable passing under the pipe and the other a chain secured to the rail to prevent the car from overturning. The railroad is narrow gage and the large pipe would easily tip the cars unless held down.



THREE MEN CAN UNLOAD A 54-IN. PIPE WITH THIS HITCH

The man on the car pinches the pipe over the edge onto the skids when the two men on the ropes lower it slowly to the ground. A small tractor is used to roll the pipe within reach of the boom of the pipe-laying machine. The entire 48,000 ft. of the conduit parallels the railway track.

The hitch was devised by J. C. Mitchell, general manager for the Lock Joint Pipe Co., which has the contract for the new conduit.

Safety Methods in Building Construction

A NOVELTY in making provision for the safety of workmen engaged in building and construction work has been used in the erection of large extensions to the plant of the American Rolling Mill Co., Middletown, Ohio. At 2 p.m. each Tuesday a committee composed of foremen, mechanics and laborers inspects the entire job from sewers to roof with the one purpose of seeing that proper methods are taken to safeguard the employees against accident. This committee makes a detailed report of each inspection to a representative safety committee, which considers and acts upon the recommendations of the inspection committee.

The plan was introduced and is being carried out by Dwight P. Robinson & Co., Inc.

NEWS OF THE WEEK

New York, September 9, 1920

Road Shipments Not Affecting Coal Program, Is Report

Charges having been made that the movement of road materials is interfering with the program of coal distribution, Thomas H. MacDonald, Chief of the Bureau of Public Roads, calls attention to the fact that his policy throughout has been to co-operate in making the Interstate Commerce Commission's orders effective.

It is true that the Bureau of Public Roads is handling applications for special permits to use open-top cars, but applications for these permits are approved only for the movement of materials to important projects, already under way, whose completion is necessary to open main lines of travel. The number of cars which have been used under this permit system has been negligible, Mr. MacDonald says, so far as having any effect on the coal program. In New England, where the problem of distribution has been most difficult, not a single permit has been granted.

Mr. MacDonald believes the best way out of the difficulty is to advance coal distribution as much as possible, with the hope of shortening the time that priority in the use of open-top cars is necessary. Despite a very general desire to secure permits to ship materials for completing street and road projects, Mr. MacDonald is insisting that no permits be granted except in cases where the project is of real importance as a link in transportation.

Engineering Council's Water-Power Committee

An offer to serve the Federal Power Commission in an advisory capacity in technical matters has been made by the Water Conservation Committee of Engineering Council. The committee will meet with Power Commission officials Sept. 10 to discuss the matter. The Water Conservation Committee consists of Calvert Townley, chairman; Charles T. Main, H. Hobart Porter, M. O. Leighton, Allen Hazen, Arthur P. Davis, Arthur E. Morgan and F. W. Scheidenhelm.

Detroit Amendments for Water and Sewer Bonds Carry

At the primary election held Aug. 31 charter amendments of the City of Detroit were carried, including authorization for the issuance of $12,000,000 in public utility bonds and $25,000,000 in public sewer bonds. Of the former, $7,000,000 will be used to extend the pumping system of water-works and $5,000,000 to extend the pumping system and build a nitration plant.

Civil Engineers at New York Condemn Amendments and Proposal to Join Federation

Contend That Amendments Conflict, That Federation Lacks Definite Program and That Both Would Be Costly

Pending amendments to the constitution and the question of joining the Federated American Engineering Societies were discussed at the business meeting of the American Society of Civil Engineers in New York Sept. 1. The meeting was spirited. The discussion, with the exception of one brief statement, was all in opposition to the amendments and to joining the federation.

Objections advanced against the amendments were that they set up expensive machinery for the nomination of officers, that they were in conflict with provisions of the constitution, that the annual conference of representatives of sections would be a heavy expense and would have no important function, and that the amendments regarding the election of officers set up a political machine which can and will be manipulated for the personal benefit of interested factions.

No objections were made to the amendments which relate to dues, honorary membership and candidacy for office of members of the nominating committee.

The proposal to join the federation was condemned on the score that no substantial worth-while program had been put forth, that it created a huge machine which, lacking problems to keep it legitimately employed, would become meddlesome, and that the cost per member, $1.50 per annum, would prove insufficient, necessitating later calls for additional funds.

On account of the straitened character of the society's finances it was argued that the society should not undertake changes or enter movements that would place additional burdens on the treasury.

A motion was carried during the discussion requesting the board of direction through the executive committee to issue the minutes of the meeting, immediately if possible, to the corporate members of the society, in order that they might have the benefit of the discussion in considering the pending vote.

Ninety-nine members were present at the meeting.

Amendments

At the suggestion of the chairman the amendments were taken up first.

Lieut.-Col. W. T. Chevalier, the first speaker, characterized the amendments as having the same purpose and effect as the reputed burning down by the ancient Chinese of their houses when they wanted roast pig. We desire to accomplish certain things—comparable to the Chinese desire to get roast pork—but he contended that we should not tear down the whole fabric of the society in order to effect desired changes.

The fundamental purpose of the proposed amendments was, he stated, to democratize the society, but the means employed was merely the erection of a "vast political machine, that carries with it everything that is connoted by that term, district leadership, log rolling and huge expense, for which," he added, "you and I are going to pay." He maintained that the finances of the society could not stand the financial strain.

But even if the money were available, he contended that the gain was not worth the cost. Ostensibly the local sections were to be exalted. As a matter of fact they had been "stabbed in the back." They were given no definite standing, but would have only such powers as the board gave them. These powers might be revoked and changed by successive boards.

If the amendments were adopted no additional members, he contended, could be elected to the society, since the constitution requires that twenty-five ballots be cast by the board to constitute an election to membership, while the proposed amendments call for a board of only twenty-four.

The proposed annual conference of representatives of sections he characterized as a "lower house," the board of direction being the senate. "The annual conference," he added, "is going to elect the senate; it is going to create the board of direction, and then, in addition, is to instruct the board how to manage the society." The conference is also to consider the welfare of the society and of its members. He believed that his hearers were competent to look after their own welfare. He maintained that the annual conference would be a very expensive undertaking, and contended that, if established, the expenses of a delegate from every section should be paid, no matter if there were sections in London or Hawaii.

He urged that the members reject the pending amendments and await the report of the committee to which certain

amendments were referred by the Portland convention, said amendments to be reported back at the annual meeting in January.

If the progressive members would present their ideas to the committee, there would be reported back in January a well-rounded and comprehensive set of amendments that are going to mean "progress and not factionalism." He concluded by an appeal for the burial of differences and the co-operation of all who have the good of the society at heart.

C. M. Holland, the next speaker, read a circular letter entitled, "An Appeal for a Progressive as Against a Radical Policy," signed by 182 members of the society, of whom over 60 are west of the Mississippi River, which is being sent to all corporate members of the society. The substance of it is given in another column of this issue.

Financial Aspects

Arthur S. Tuttle (treasurer of the society), commenting upon the references that had been made by Colonel Chevalier to the financial status of the society, estimated that the deficit for the year 1920 would be $22,000. Of that deficit a portion would be passed over to the next year through the deferring of the publication of the *Transactions*. If the society joined the federation, the deficit, even if the dues of non-resident members were raised $5, would be, he estimated, about the same next year.

L. D. Rights declared that he favored the incorporation in the constitution of some of the ideas expressed in the amendments, but that he could not favor the pending set because they were not properly co-ordinated with the remainder of the constitution. He pointed out the curtailment in the *Proceedings* and maintained that thereby the discussion will be curtailed. He believed that changes which would involve further expense should be postponed, since even under present financial conditions one of the most valuable parts of the society's work must be sacrificed.

George L. Lucas objected to the second amendment, with reference to assignment of members to local sections, because it would not require that a member shall be identified with a local section in the geographical district in which he resides, nor would it prevent him from belonging to several sections if he so desired.

The amendments take no cognizance of the fact that Article 6, Section 7, of the constitution provides that at least three members of the finance committee and two members of the other standing committees shall be resident within fifty miles of New York. Since the secretary, under the proposed amendments, would no longer be a member of the board and it would be no longer obligatory that one of the vice-presidents be a resident member, the effect of the provision would be that two out of the resident directors would be obliged to serve on both the publication and library committees and all three on the finance committee, unless the treasurer be appointed on the committees, which had not been the usual practice. This would give a few resident members of the board undue preponderance in handling the affairs of the society through committees.

The amendments relating to the number of officers introduced confusion because the nominating committee, which has just functioned, has, provided the amendments be carried, named more candidates than there will be offices to fill. Two directorships would be abolished, but nominees for these offices had already been named.

Replying to a question by the chairman, Mr. Tuttle, the treasurer, said that he had heard an estimate that it might cost $16,000 a year for the expenses of delegates to the annual conference. This was based upon the fact that we have eighty cities in the United States with a population of over 100,000 [there are about 70 such cities—Editor] and that therefore we might have eighty sections. Traveling expenses per delegate were assumed at $200 each. The estimate, he said, was roughly made. It might be increasd by an added number of sections, or decreased if the expense of $200 per delegate was too high. The chairman, Francis Lee Stuart, commenting upon the estimate, believed that the society was not warranted in spending so much "for political purposes."

A. P. Hoover believed that it was a mistake to remove the secretary from the board of direction. No one, he thought, was better qualified to be a member of the board than the secretary.

Question was raised whether the charter of the society allowed a change in the number of directors, but no one could answer it. Dr. Hunt, secretary emeritus, called attention to the exemption of the society from taxation under the laws of the State of New York. In order to secure that exemption it was necessary to sue the City of New York and to prove that the society was purely a scientific organization. He could not say whether Amendment A (expanding the objects of the society) would interfere with that exception or not, but he believed it a mistake to amend the constitution before legal opinion was had on the subject. Since the society is one-fourth owner of the Engineering Societies Building, the taxes would be quite heavy. The chairman replied that legal advice was being sought on the subject.

The Federation

Turning to the proposal to join the Federated American Engineering Societies, Colonel Chevalier again took the floor. He believed we had been regaled with too much rhetoric regarding the federation and not enough "cold-blooded and dispassionate consideration of just what we are going to get for the price we are to pay." It was generally agreed that the professional man should receive greater respect and that the public should get the benefit of the engineering point of view concerning questions of a technical nature.

Granting that the things to be accomplished are what we desire, were they worth the price?

First, there was a material price—$1.50 per year for each member of the society. In his opinion, if the members of the society would get what they thought they were going to get, it was not enough. "If we are going to buy welfare work," he said, "it is my judgment that we will be buying it on margin and that sooner or later we will have to put up or be sold out." The experiences of the A. A. E. have proved that welfare work cannot be done for a small sum per member. If the work was worth having, it was worth paying for, and until we were in a position to pay for "an all-wool article" he did not think "we ought to go flirting with a proposition on a margin."

But there was another price that had to be paid: the American Society of Civil Engineers had to pool its goodwill "in this holding company." "The American Society of Civil Engineers," he continued, "has a prestige that comes very nearly being first in the world for a society of this sort. This has been built up over a long period of years by adherence to a policy of rigid selection, of high professional qualifications, by holding men up to these qualifications, and by seeing that the pin which we are proud to wear stands for something." Though the society had been criticised, there were more members coming in than ever. It was his opinion that if the society "delivered the goods" as it had in the past engineers that are worth having will continue to knock at its doors. There are no qualifications as to membership in the federation and other bodies with lower standards would direct the federation. The society would give up the control of its name, for the actions of the federation, he contended, would be the actions of the American Society of Civil Engineers in the eyes of the world. We were asked to put the society in the hands of an organization in whose management we would have an insignificant representation.

For the price that would have to be paid—in money and in prestige—he had been unable to learn what the return would be. The federation's bulletin No. 3 purported to explain the purposes of the organization. There were nine pages in the document, of which seven were devoted to telling the goods things that Engineering Council, which the federation is to displace, had accomplished. The remainder consisted of generalities.

He mistrusted such statements as that the federation was "to use its power for the service of the community, state and nation in public affairs wherever engineering experience and technical knowledge are involved." He feared that that would lead to interference with governmental employees.

Instead of the proposed type of federation, he favored joint committees of

(*Continued on p. 528*)

Good Roads Campaign To Be Started in Argentina

Movement Proposed by S. T. Henry Backed by Argentine, American and British Business Houses

A nation-wide, good-roads educational campaign is to be launched soon in the Argentine Republic. A large number of prominent Argentine, American and British business houses of Buenos Aires have formed a good roads association of the Argentine Republic for this purpose. This organization will demonstrate the value of good roads by methods which have been effective in similar work in the United States.

The primary object of the new association is to bring together every one who is interested in any way in good roads in the Argentine Republic. Information about how good roads are financed, constructed and maintained will be collected in countries where conditions are similar to those in the Argentine. This information will be interpreted in such a way as to make it the most effective for use in that country. It will be put out in various ways. Printed matter of different kinds will be used; plans for a series of moving pictures have been made; in some cases speakers informed on the benefits of good roads will be employed.

The movement was started as a result of a speech made at a luncheon of the American Club of Buenos Aires by S. T. Henry, vice-president of the Allied Machinery Co. of America. Mr. Henry outlined the great effectiveness of the good roads educational work that has been done by the American Automobile Association, the Portland Cement Association, the Federal Highway Council and other American organizations. He urged all American concerns whose business in the Argentine depends in any way on good roads to get together in support of a similar good-roads campaign. He suggested that an organization, formed for this purpose, could co-operate with the Argentine government in the same manner that similar private associations in the United States work with Federal and State highway officials. He stated that several important Argentine, American and British concerns had offered to back such a movement if proper plans were adopted.

Immediately after Mr. Henry's address an organization committee was formed. This committee received help from all of the many lines of business interested in good roads. After several preliminary meetings a tentative form of constitution and bylaws for the association was adopted. A board of directors was elected, but the election of other officers was postponed until later. It is planned to have Argentinos of the highest standing serve as president, vice-president, secretary and treasurer. The directors desire, however, not to ask such men to take these positions until ample funds to carry on the proposed work have been raised.

Temporary Organization Formed

A group of local business men have underwritten a temporary organization. It is thus certain that the movement will go ahead until the plans can be presented to the concerns most interested in supporting it. J. N. Wisnor, who was manager of the United States Chamber of Commerce in the Argentine from the start of that organization until recently, has been employed to manage the association during the organization period.

From the start it was evident that this movement would receive the most cordial moral support of the Argentine people. The board of directors were notified to call upon the Minister of Public Works, who assured them that he would do everything he could to help. Many Argentinos have joined the association, although the directors decided not to make an effort to get individual members until proper financial support was certain. It has been planned to secure then the greatest possible number of individual members in all parts of the country. To this end dues for individual membership will be made very low. Most of the funds will be raised from subscribing members.

Argentine managers and agents of the American concerns will appeal to their home offices for funds with which to help make a success of the movement. It is planned to raise at least $150,000 for the first year's work. Several large subscriptions were promised as soon as the personnel of the directors and the manager was known. Most of these came from managers of American interests, who realize the great impetus which good roads in the Argentine would give their business. Every American manufacturer of automobiles, motor-trucks, accessories and supplies who wants to keep up his present volume of business, or to make greater sales in that country, doubtless will support the new organization financially. Several manufacturers of gasoline, oils, road materials, cement and road machinery have also signified their desire to help.

The board of directors asked Mr. Henry to present the plans of the association to the executives of American manufacturers, who ought to be interested. He will do this soon after his return to the United States this month. In the meantime plans for good-roads educational campaigns in different parts of the Argentine are being worked out. Studies of available road-making materials also are being made. Other preliminary work has been started, so that the movement can be pushed vigorously as soon as sufficient finances are available.

Road-building in many parts of the Argentine has been widely considered to be impracticable. American engineers who have recently studied conditions in the most developed sections of the country report otherwise. They are convinced that the difficulties to be overcome are not nearly so serious as those which have been solved in many places in the United States. The great private wealth of the Argentine is of course ample to carry on a good-roads program relatively as large as anything that has been done in this country. The chief reason why the Argentine has built no roads seems to be a lack of understanding by the average citizen of the great national importance of good roads. It also apparently is not known that good roads can be secured in most places in the Argentine at a very reasonable cost. The association that has been started ought to be able to change this entire situation rapidly.

Make Plans for A. S. M. E. Annual Meeting

According to present plans for the annual meeting of the American Society of Mechanical Engineers in New York, Dec. 7-10, the keynote session will be devoted to the subject of transportation, with addresses by prominent men in that field. This session will include consideration of the railroads, waterways, motor trucks and terminals.

Special sessions will be held by the professional sections on fuels, management, machine shop, power, railroads and textiles. A subcommittee has been appointed on the subject of engineering in woodworking, with Thomas D. Perry, Grand Rapids, Mich., chairman.

It is planned to devote one session of the meeting entirely to the subject of appraisal and valuation.

Notes From the Corps of Engineers

Col. Henry C. Newcomer, Corps of Engineers, U. S. A., who has been department engineer for Hawaii and a commander of the third regiment of engineers, has been ordered to New Orleans to serve as division engineer of the Gulf division. He relieves Col. Herbert Deakyne, who goes to San Francisco to become division engineer of the Pacific division, district engineer of the first San Francisco district and a member of the California Debris Commission. Col. Deakyne will relieve Col. E. Eveleth Winslow, who goes to Governors Island as Corps Area engineer of the Second Corps area. Col. Winslow will relieve Col. William W. Harts, who is to go to Cincinnati as division engineer of the Second division. Col. Harts will be designated as a member of the Mississippi River Commission.

Col. William J. Barden, who is under assignment to become division engineer at Cincinnati, has been ordered instead to Florence, Ala., to take over that district. The post is one of unusual importance at this time, due to the construction of the Wilson dam.

Civil Engineers Condemn Amendments

(*Continued from p. 526*)

local or regional organizations, since most questions that require concerted action are of a local character. Only relatively few become of national scope and it was uneconomical, in his opinion, to build up a big organization merely to have it in wait when these few questions did arise.

He feared that the big organization would have so little work coming to it logically that it would begin to create jobs for itself. The machinery, he thought, should grow out of the need for it. We should build from the bottom up and make each step justify itself, instead of starting from the top and trying to find work to make the top worth while.

He pointed out that in the article in the *Engineering News-Record* recently on the organization of other professions Charles Whiting Baker had indicated that welfare work is handled through local rather than through national organizations.

George W. Fuller believed that the procedure at Portland was a disorderly one when, instead of taking the board's advice of allowing the matter of joining the federation to be referred to the society's counsel, the meeting instructed the board to send out the ballot at once, without waiting for such legal report.

He believed that there was a certain amount of welfare work to be done, but felt with Colonel Chevalier that an organization should be developed from the bottom up. He spoke with commendation about the San Francisco Engineering Council, which later was followed by a State Engineering Council. He believed that this idea might be extended to the establishment of regional engineering councils as well. The regional conferences, in turn, could head up in a national conference. The local bodies would pay the expenses of their delegates to the state and district councils. He did not believe that the proposed federation represented a real need of the engineering profession. He hoped that the proposal to join the federation would be defeated as it was in April of this year.

L. D. Rights also spoke against joining the federation, proposing instead that the society should strengthen its local sections by giving them an adequate amount of money and letting them take care of local and state affairs of a civic nature. He believed that the dues should be made uniform, at $25 per annum, in order to do this. He felt there would be quicker results from such a plan and that the membership would get more for their money than by joining "any diversified federation."

Frederick C. Noble maintained that the present form of the federation is substantially the same as that which was voted on last spring. The representation of the society had been increasesd from about 5½ per cent to 8, but he did not consider that an essential change in the proposal. In the Executive Council the society would have two members out of the thirty.

Lieut.-Col. F. W. Scheidenhelm asked if there were not some one in the room who would speak in favor of the federation. The only response was from W. C. Briggs, who stated that he believed the society should join the federation because it was the only concrete proposal that had been made to meet "a desire that is latent in a very large body of the membership." He was sympathetic to the discussion of the evening, but if we could not get something better than the federation he thought that the society should join it.

Colonel Scheidenhelm then asked a number of questions: (1) Whether it would be possible to get the co-operation of other engineering societies in some alternative scheme; (2) whether it was felt that the American Society of Civil Engineers had a higher set of ideals than other societies, so high that it barred it from getting into an organization with other bodies; (3) whether the society, if it should refuse to go into the federation, would face the same position as it did some years ago when it decided to come into the Engineering Societies Building after having once refused to participate.

Colonel Chevalier believed, answering Colonel Scheidenhelm, that co-operation of other societies could be secured for an alternative plan. He did not maintain that the members of the American Society of Civil Engineers were of "superior clay," but that the society had certain standards which it was its duty to maintain without making comparisons with the standards of other organizations. He considered that these standards would be endangered by joining the federation.

No attempt was made to answer the third question, but Dr. Hunt pointed out that after refusing to come into the society building in the first instance applications for membership quadrupled inside of a month. Dr. Hunt also stated that if, when the proposal came up the second time, the society had not entered the building, it would now have money enough to join the federation and to spare.

Lieut.-Col. J. P. Hogan, replying to Mr. Briggs, maintained that the mere fact that no other concrete proposition was before the society was not a valid argument for voting favorably. It was the duty of the members to inquire as to the workability and probable success of the scheme. He believed the federation to be incapable of practical action and felt that it would be "entirely a political organization," and that it would have possibilities of becoming a public nuisance. In joining a federation we should seek to join with those with whom we can get along or who are "the same sort of crowd that we are ourselves." The federation, however, was to be composed of at least seventy-five "diversified societies of varying purposes and varying standards from all over the country."

Appeal for Am. Soc. C. E. Negative Vote

Defeat Urged by 182 Members So That "Sound" Amendments Can be Considered at Annual Meeting

One hundred and eighty-two members of the American Society of Civil Engineers have joined in an appeal for a defeat of the pending amendments, except those relating to dues, honorary members and candidacy for office of members of the nominating committee. The circular, which is entitled "An Appeal for a Progressive as Against a Radical Policy," has been mailed to all corporate members of the society. Those signing the appeal class themselves as "progressives," and infer that they favor reorganization. They hold that the pending amendments are "disjointed and unco-ordinated." Their defeat is urged, so that the society can at the annual meeting consider the report of the committee to which certain amendments were referred, it being the expectation of the signers that the committee will present "a thoroughly worked-out and comprehensive plan for the amendment of the constitution along sound and progressive lines."

No reference is made in the circular to the referendum regarding membership in the Federated American Engineering Societies.

The reasons advanced against the amendments are as follows:

(*a*) They do not represent the mature views of any representative body of the society. They were conceived by a faction, were worked over and modified at Portland, Ore., and were railroaded through a convention in that city made up of less than 2 per cent of the membership of the society. These amendments are not those formulated by the committee of the board of direction appointed for that purpose. They are almost entirely the product of the radical faction of the society.

(*b*) They are so vague and unco-ordinated that, if adopted, they will give rise in all probability to protracted strife and perhaps litigation that may keep the society in a turmoil for an indefinite time. This resulted from the lack of legal advice and from the tinkering to which they were subjected up to the moment they were voted on, in an attempt to reconcile inconsistencies that continued to come to light even at the eleventh hour.

(*c*) In the endeavor to democratize the society, these amendments tend toward the establishment of a political machine in which the average society member will probably take little interest. Its manipulation will soon fall into the hands of those who will be enabled by it to exploit the society for personal and political advantage.

(*d*) By the introduction of an elaborate system of political machinery the society is committed to an absolutely unknown and unestimated drain upon its treasury, already laboring under a material deficit. Until this financial problem has been attacked and solved, we must not write into our constitution provisions that may involve the society in serious financial embarrassment.

(*e*) The manner in which the Local Sections have been handled in these amendments leaves them without any standing or place in the society. To them are assigned important administrative functions, but no plan is laid down for their support. Their very rights, powers and existence are subject to the whim of each successive board of direction. We believe that the local section should be incorporated in the organization of the society and that it should be established on a solid basis in the constitution. The treatment of the local section illustrates the loose-jointed manner in which the entire question of society reorganization has been handled throughout these amendments.

E. S. Alderman, J. N. Ambler.
W. E. Baldry, W. Baldwin, S. Barfoed, C. Bates, R. N. Begien, W. L. Benham, L. E. Bishop, E. B. Black, R. D. Black, W. L. Breckinridge, H. E. Breed, G. D. Brooke, W. G. Brown, D. J. Brumley, W. W. Brush, W. V. Buck, R. D. Budd, C. B. Burdick, L. Bush.
F. W. Cappelen, E. I. Clawiter, W. T. Chevalier, V. H. Cochrane, M. C. Couchot, A. S. Crane, M. L. Cunningham, C. H. Currie.
A. L. Dabney, P. A. Dallis, J. V. Davies, G. S. Davison, C. Derleth, Jr., H. D. Dewell, G. C. Diehl, G. L. Dillman, A. S. Downey, B. S. Drane.
T. Earle, J. R. Elliott, F. W. Epps, A. C. Everham.
F. H. Fay, C. F. W. Felt, R. Fletcher, S. J. Fortin, G. W. Fuller.
J. D. Galloway, W. B. Gester, L. S. Gillette, C. R. Gow, E. M. Graham, R. C. Gray, H. R. Green, B. F. Groat, F. M. Gunby.
J. L. Harrington, F. D. Hartford, R. T. Hartman, E. M. Hastings, J. H. Haylow, A. Hazen, S. H. Hedges, A. S. Hirzel, J. P. Hogan, C. A. Holden, C. M. Holland, H. C. Holmes, R. Hortenstine, E. E. Howard, E. T. Howson, C. R. Hulsart, E. B. Hussey, E. C. Hutchinson.
R. H. Jacobs, J. H. Johnston, F. G. Jonah, W. N. Jones, J. D. Justin.
F. M. Kerr, V. H. Kriegshaber, K. B. Kumpe.
H. A. Lane, G. H. Leland, E. E. Lochridge, C. F. Loweth, G. L. Lucas, J. L. Ludlow.
D. W. McNaugher, E. R. Mack, H. L. Maier, A. Maitland, Jr., C. T. Main, R. R. Marsden, J. B. Marsh, D. H. Maury, J. S. Means, C. A. Mees, R. A. Meeker, W. Meredith, R. Messer, A. F. Meyer, C. A. Mead, A. N. Miller, R. E. Miller, L. V. Morris, B. S. Morrow, F. R. Muhs, E. T. D. Myers, Jr.
W. R. Neel, A. M. Nelson, A. W. Newton, C. S. Nichols.
M. M. O'Shaughnessy, A. E. Owen.
R. S. Parsons, W. B. Parsons, I. W. Patterson, J. N. Pease, C. L. Pillsbury, J. H. Polhemus.
R. I. Randolph, F. M. Randlett, A. R. Raymer, C. H. Reeves, A. F. Reichmann, E. H. Reidpath, C. J. Rhodin, A. O. Ridgway, J. Rosenwald, James G. Ross, H. B. Rust.
H. R. Safford, N. H. Sayford, H. L. Shaner, W. C. Shaw, Jr., W. J. Schlick, W. F. Schulz, F. C. Shenehon, L. K. Sherman, F. B. Smith, J. W. Smith, L. B. Smith, G. R. Solomon, C. M. Spofford, C. L. Strobel, R. M. Strohl, H. A. Sumner, R. S. Sumner, A. R. Swem.
A. J. Taylor, S. A. Taylor, R. D. Thomas, R. H. Thomson, J. L. Tighe, G. W. Tillson, L. R. Tillotson, H. P. Treadway, A. A. Trocon, R. D. Trimble.
S. N. Van Trump.
N. E. Waddell, B. H. Walt, W. T. Walker, G. S. Walsh, J. J. Walsh, T. J. Wasser, J. D. Wardle, H. A. Wells, H. F. Wiedeman, J. R. Wilbanks, F. Wilcox, W. G. Wilkins, G. L. Wilson, W. J. Wilgus, P. B. Winfree, F. E. Winsor, C. C. Witt, D. Witten, J. R. Worcester.
J. J. Yates.

Private Firm Named to Make State Rail Valuation

On Aug. 24 announcement was made of the selection of the engineering firm of Ford, Bacon & Davis, New York City, to do the actual work of appraising all electric railway properties in the State of New Jersey in accordance with the law passed by the legislature last April. When the measure was passed it was promptly vetoed by the governor on the grounds that it was loosely drawn and invited litigation, and was then passed over his veto. According to the measure, the valuation commission is to consist of the governor, the state treasurer, and the comptroller. The governor, however, has refused to serve and the valuation will be carried out under the general direction of State Comptroller Bugbee and State Treasurer Read, who have appointed the firm of engineers to do the actual field work and computations. The law provides that the value found be used in rate proceedings.

David Chauncey Shepard—Pioneer Railroad Builder

David Chauncey Shepard, pioneer builder of the Northwest and one of the foremost railroad builders of the country, whose death in St. Paul, Aug. 7, was announced in this journal Aug. 12, was engaged both as engineer and contractor in railroad building from the age of 20 until his retirement at the age of 66. He was born near Geneseo, N. Y., Feb. 20, 1828, his education consisting in attendance at the district school, the Temple Hill Academy and the Brockport Collegiate Institute. In 1847 he was appointed a member of the engineering corps engaged in the construction of the Genesee valley canal. His first railroad position was secured in 1851 on the old Rochester & Genesee Valley R.R., now a part of the Erie system. From 1853 to 1870 he was, successively, chief engineer of the Atlantic & Great Western, the Milwaukee & Beloit, the Minnesota & Pacific and the Chicago, Milwaukee & St. Paul railroads.

As a contractor Mr. Shepard superintended the construction of railroads in thirteen states and in Canada. The total mileage built by his firms is 7,026, of which 6,666 miles are in the Northwest. W. P. Kirkwood, of St. Paul, in an article in the *Bellman*, several years ago, gives Mr. Shepard's record of railroad building as follows: Minnesota, 1,452 miles; North Dakota, 984 miles; South Dakota, 950 miles; Montana, 858 miles; Iowa, 859 miles; Missouri, 61 miles; Ohio, 40 miles; Indiana, 42 miles; Illinois, 217 miles; Nebraska, 43 miles; Wisconsin, 236 miles; Idaho, 80 miles; Washington, 439 miles; and Canada, 725 miles. In 1882-3 he built 675 miles of railroad from Oak Lake to Calgary, on the Canadian Pacific, in 15 months, a remarkable record for those times. Later, on the Great Northern, from Minot, N. D., to Helena, Mont., he made a new record by laying 100 miles of track per month, laying 643 miles between April 1 and Nov. 18, 1887. While these records were being made, Mr. Shepard had under his direction 9,000 men and 3,500 teams. He retired in 1894.

Program of Ontario Engineers' Professional Meeting

The program of the seventh general professional meeting of the Ontario Provincial Division of the Engineering Institute of Canada, to be held at Niagara Falls, Ont., Sept. 16, 17 and 18, 1920, is largely devoted to the consideration of hydro-electric and waterway developments. On the first day of the meeting an inspection of the Welland Ship Canal will follow an illustrated talk on this waterway. Papers and motion pictures of the Queenston-Chippewa development will precede an inspection of this work on the second day of the meeting. On the third day there will be shown a demonstration of the Gibson method of measuring the flow of water in closed conduits. The meeting is being held under the auspices of the Niagara Peninsula Branch of the Institute.

Water Power League to Meet

The Water Power League of America, whose office is at 116 Nassau St., New York City, will hold a convention in Washington, D. C., Oct. 7-8, 1920, at which representatives of all the states, manufacturers, and power producers will gather to discuss the possibilities presented under the new Federal Water Power Act. The purpose of the convention is to afford an opportunity to the several states that are interested in water-power development to have their representatives come in contact with the Federal Power Commission with a view that there may be evolved a workable program which will co-ordinate the activities in those states with those of the Federal government.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

SOUTHWEST WATER WORKS ASSOCIATION, Waco, Tex.; New Orleans, La., Sept. 20-23.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA, Sterling, Ill.; St. Louis, Sept. 21-23.

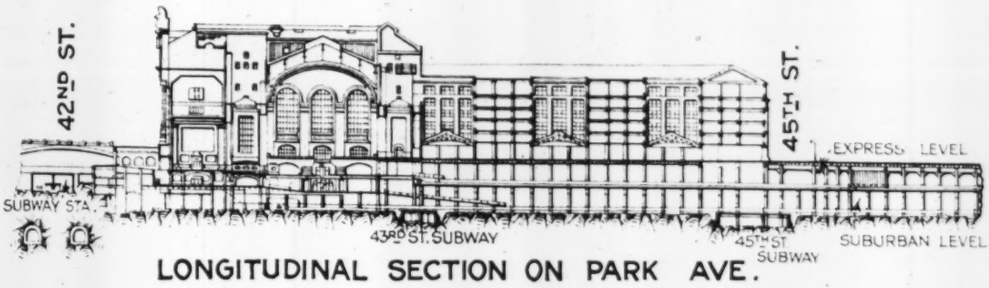
AMERICAN ASSOCIATION OF PORT AUTHORITIES, Montreal; Chicago, Sept. 30-Oct. 2.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; St. Louis, Oct. 10-15.

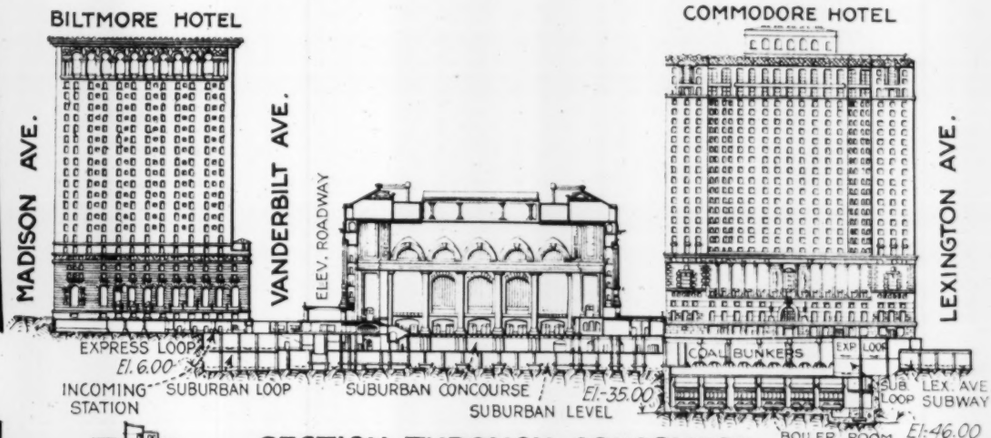
AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, Chicago; Atlanta, Ga., Oct. 26-28.

The Detroit Engineering Society held its fall meeting, Sept. 3. Prof. John C. Parker, department of electrical engineering, University of Michigan, spoke on "The Engineer in Organized Society—What Is Hampering His Recognition?" Past-President D. J. Sterrett, delegate of the society at the Organizing Conference, held in Washington, D. C., in June, presented his report on the Federated American Engineering Societies. At a meeting of the society, Sept. 17, Charles Evan Fowler, consulting engineer, New York City and Detroit, will speak on the subject of "Harbors and Harbor Bridges," with particular reference to the proposed Detroit-Windsor bridge.

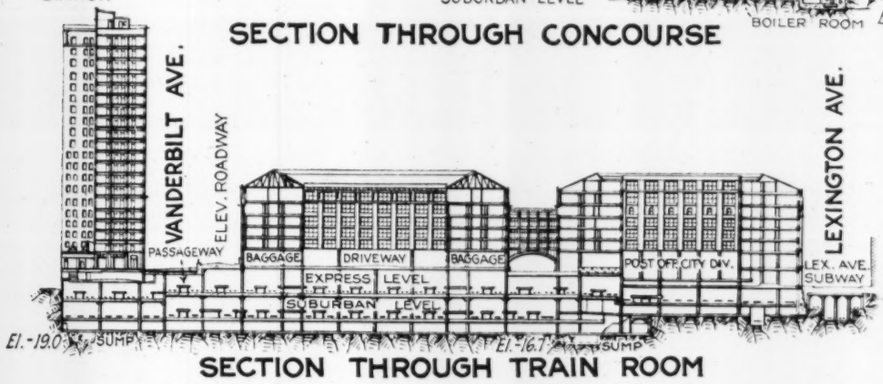
The Engineers' Club of Lansing, Mich., has been granted a charter as a local chapter of the American Association of Engineers. Officers of the club who will continue as officers of the chapter are: President, C. A. Melick, bridge engineer, Michigan State Highway Department; vice-president, R. K. Steward, professor of drawing



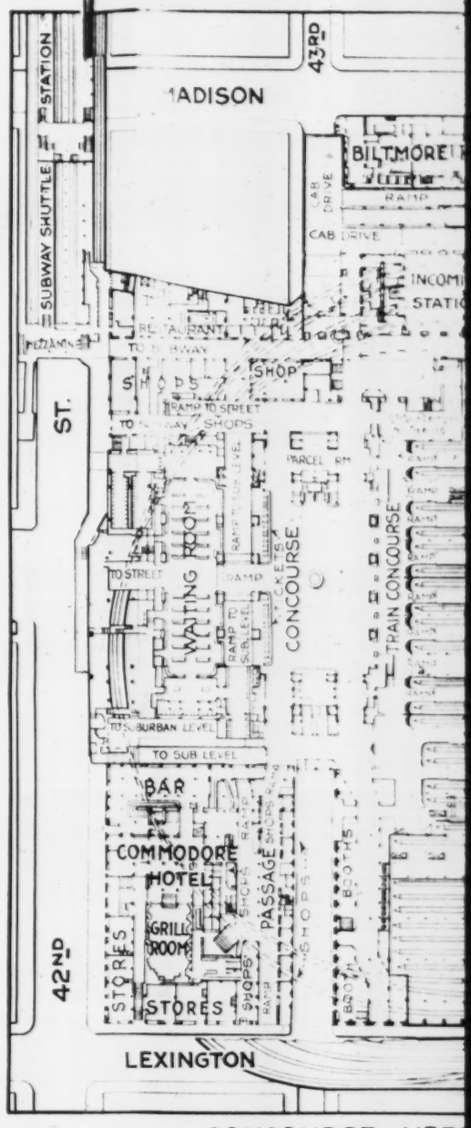
LONGITUDINAL SECTION ON PARK AVE.



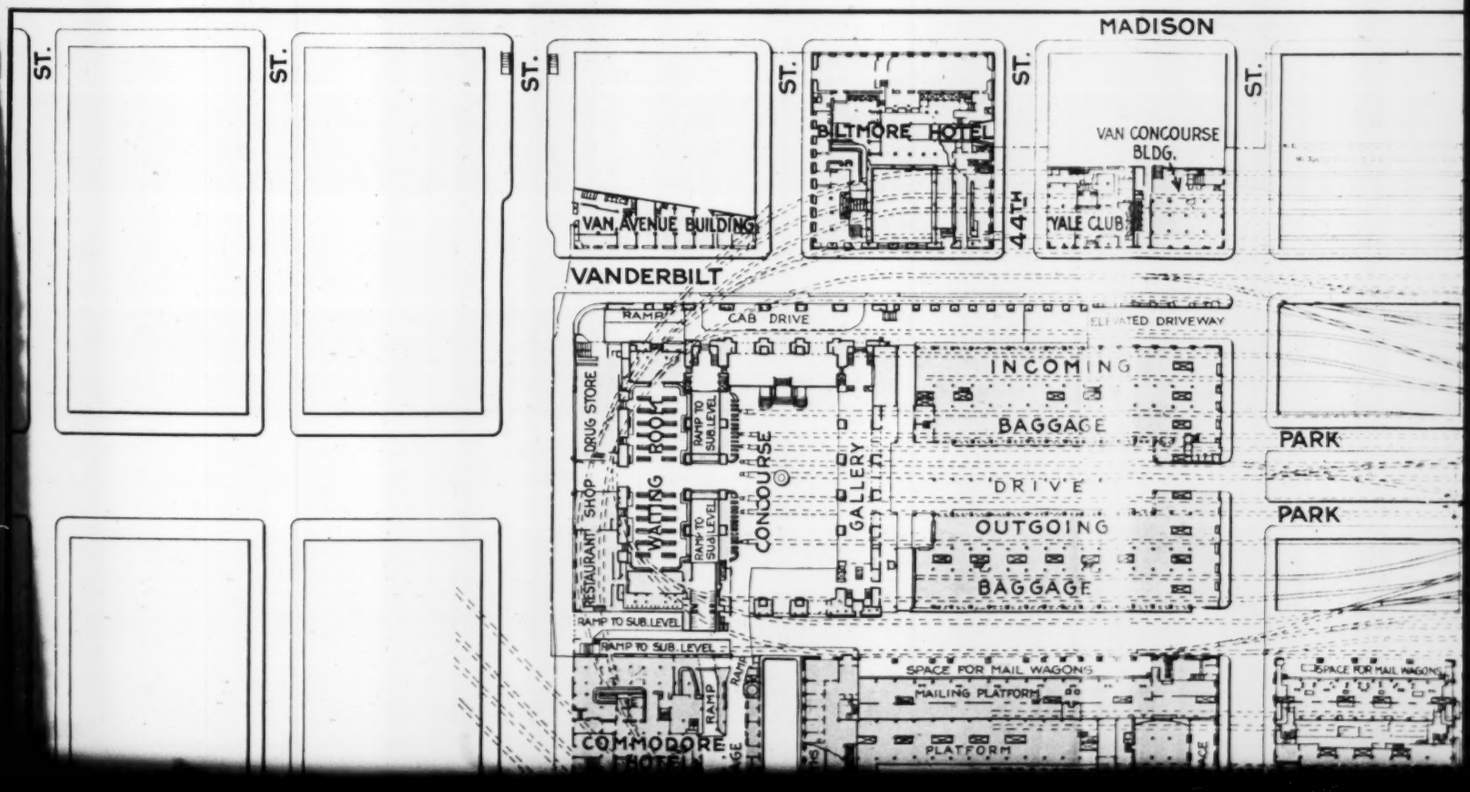
SECTION THROUGH CONCOURSE

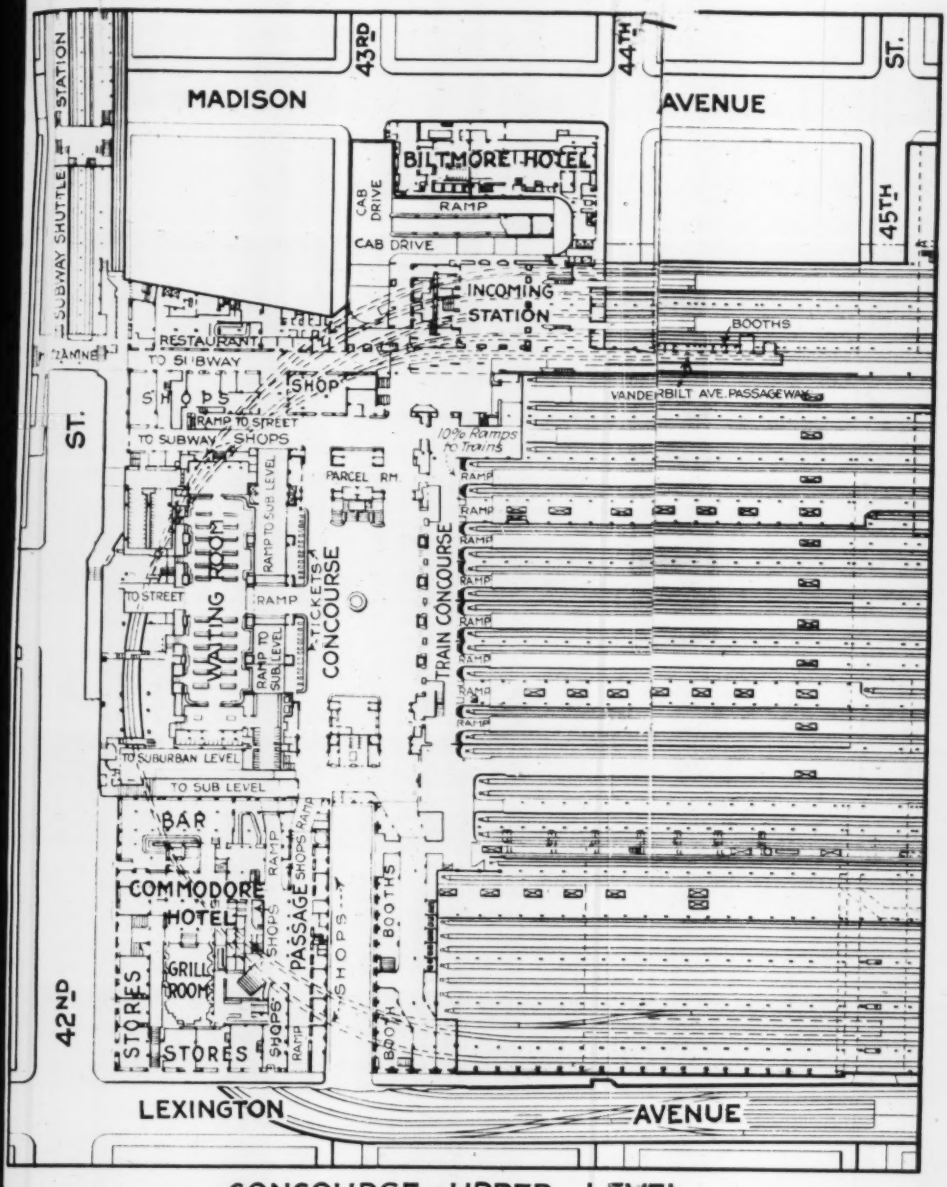


SECTION THROUGH TRAIN ROOM

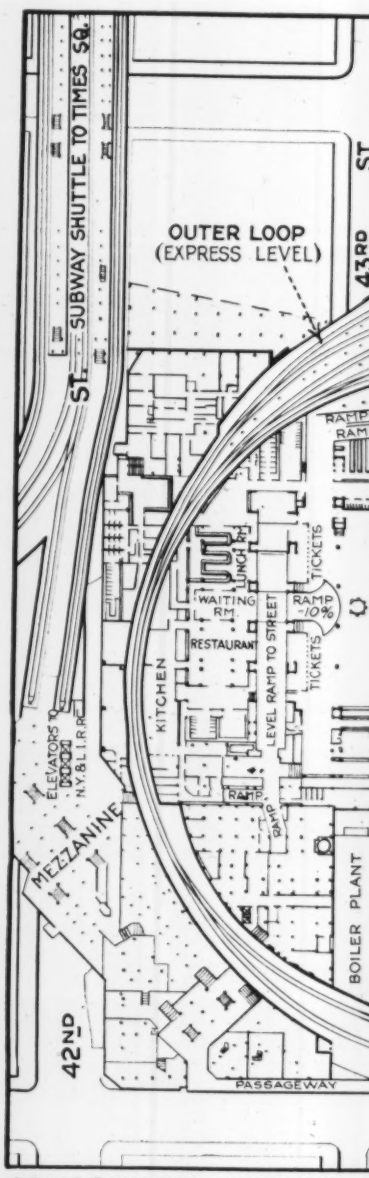


CONCOURSE - UPPE

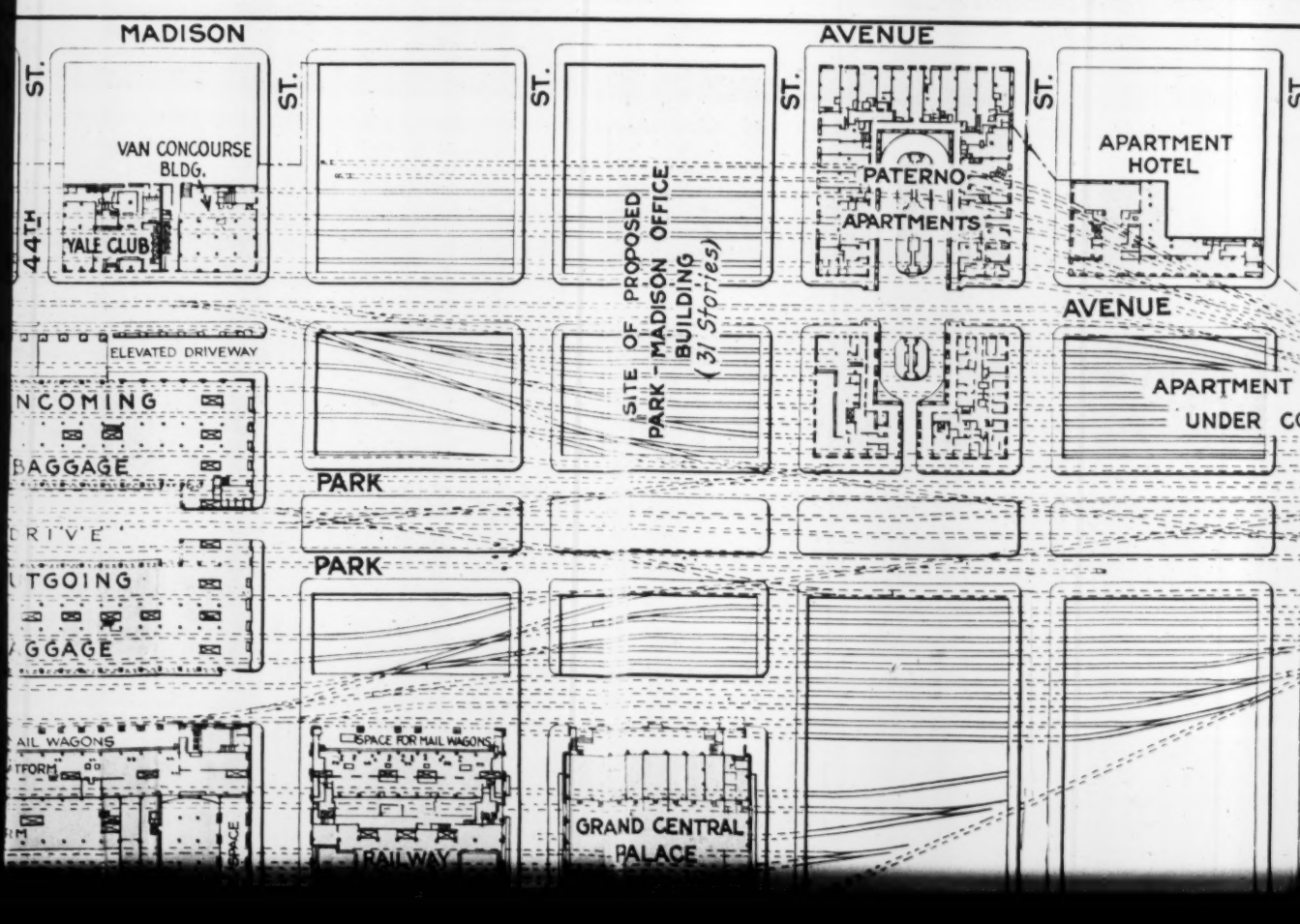


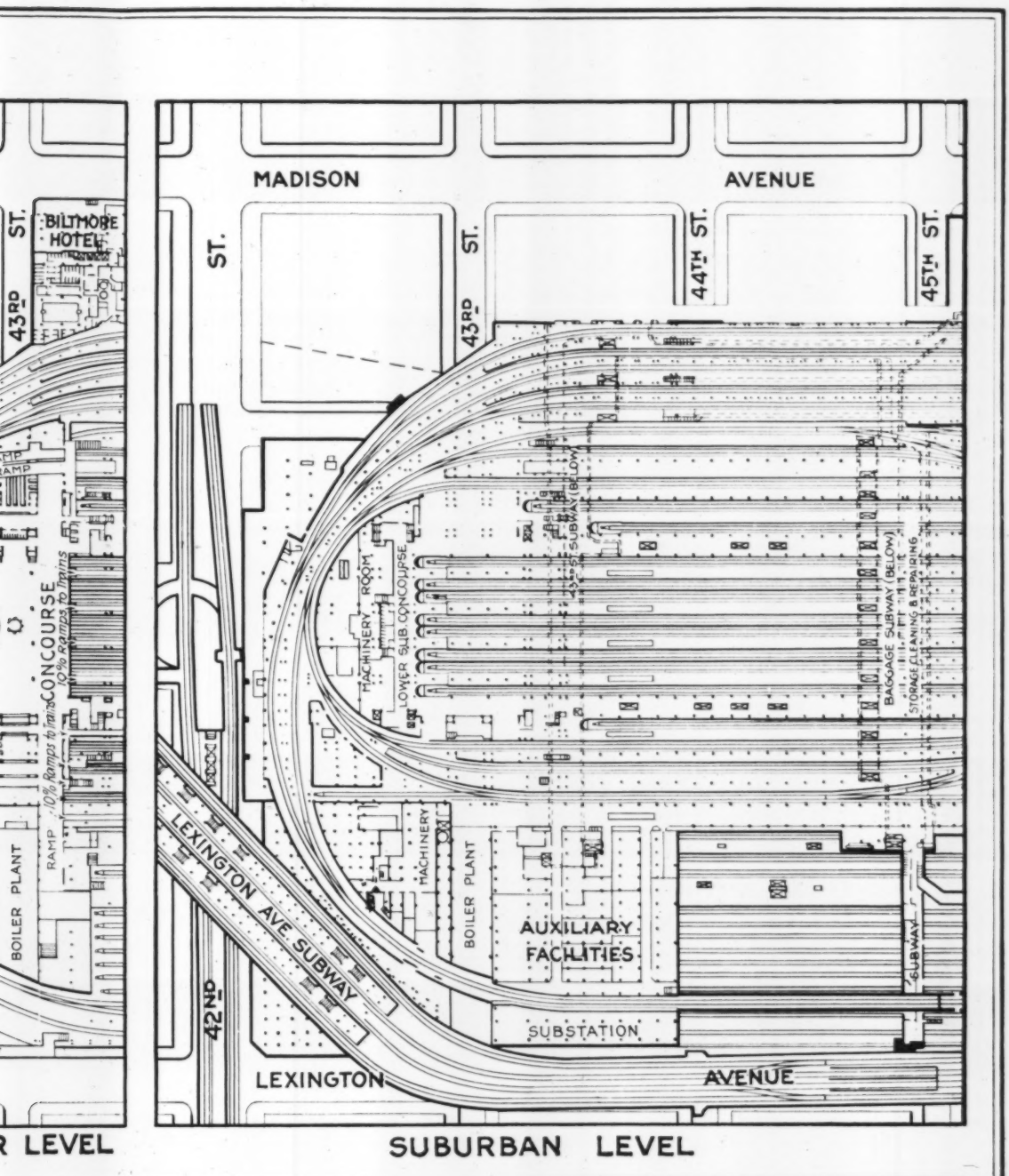


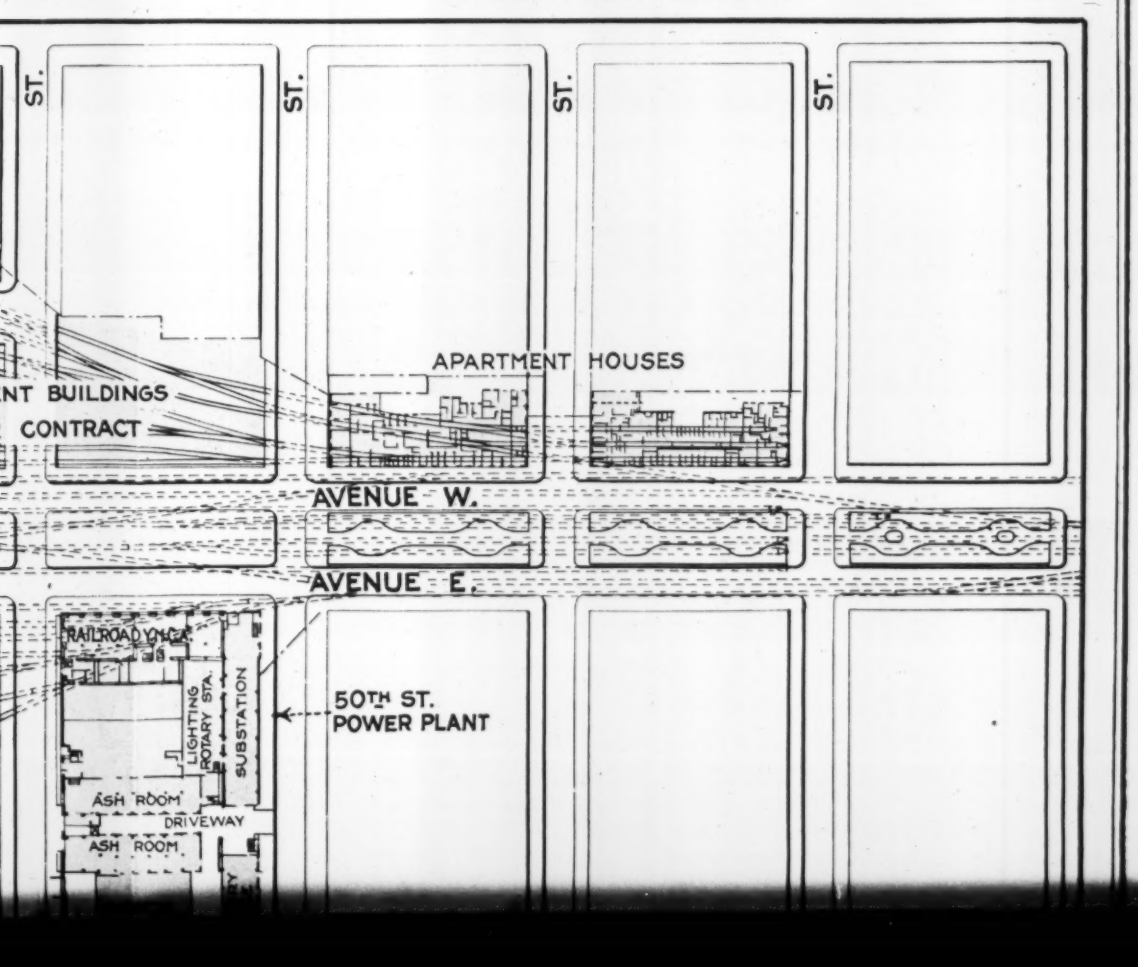
CONCOURSE - UPPER LEVEL

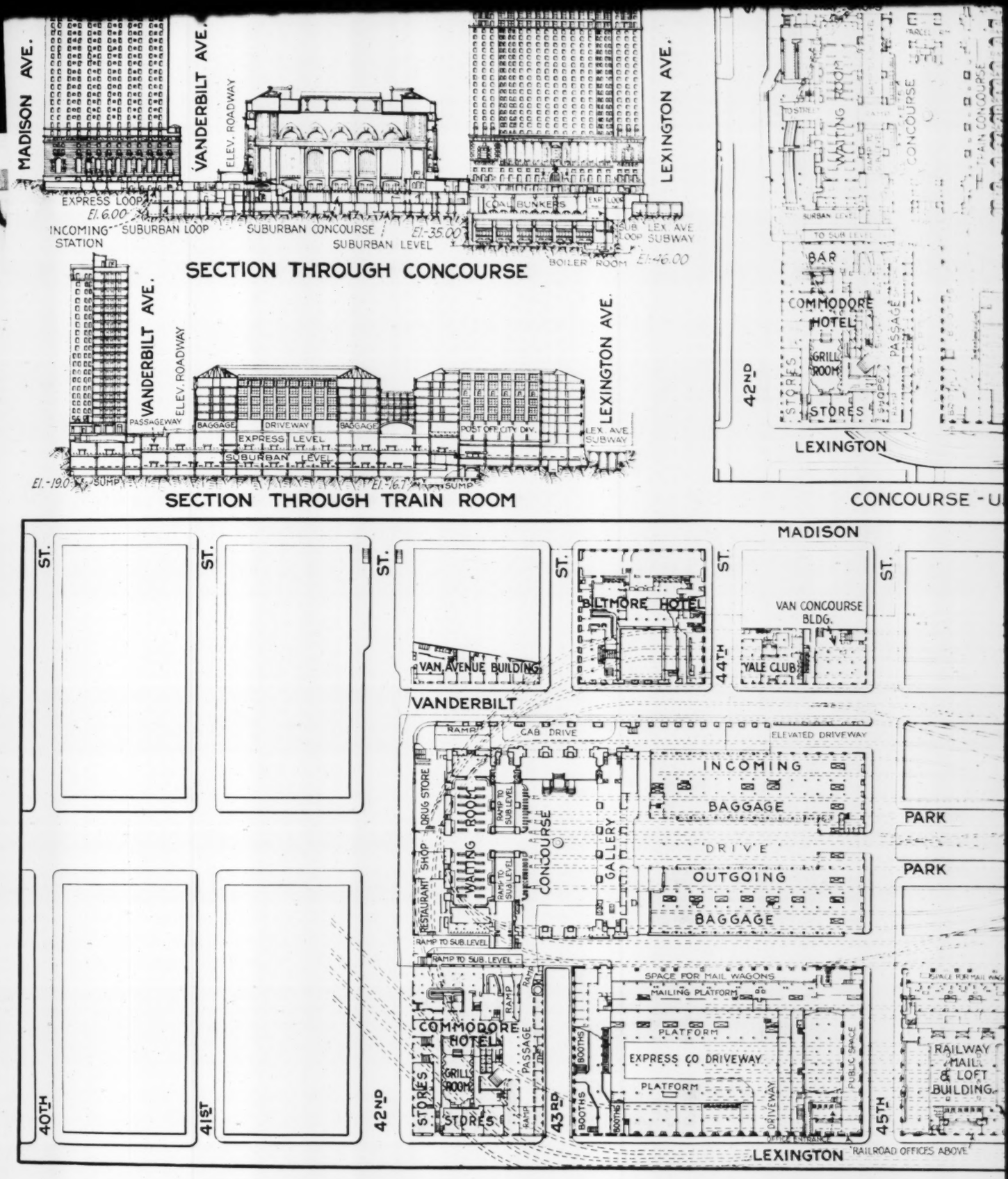


CONCOURSE - LOWER L



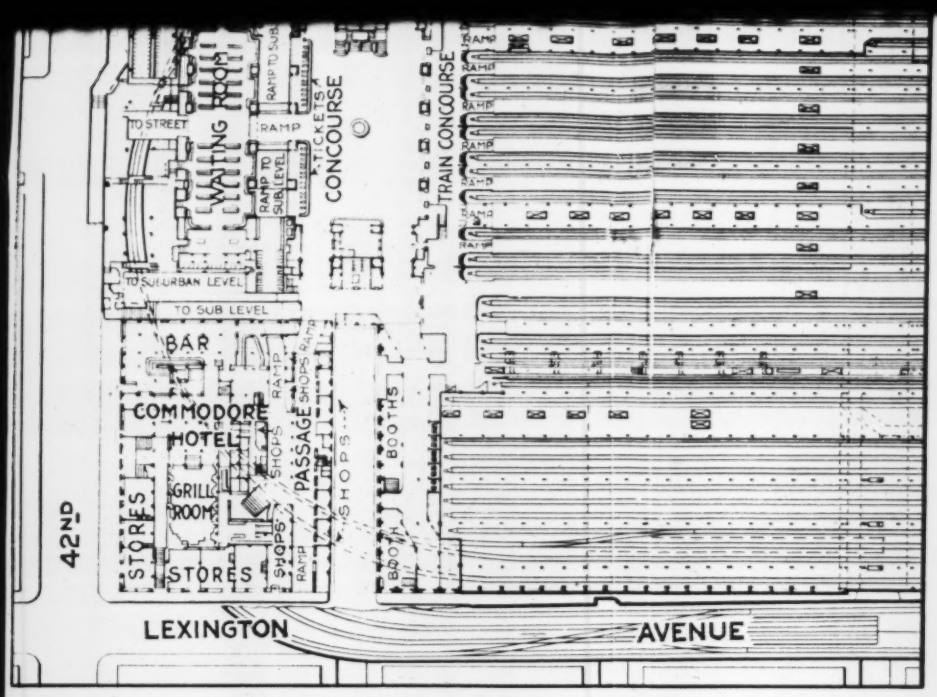

MADISON
AVENUE
ST.
43RD ST.
44TH ST.
45TH ST.
BILTMORE HOTEL
CONCOURSE
10% Ramps to trains
RAMP
BOILER PLANT
MACHINERY ROOM
LOWER SUB. CONCOURSE
SUBWAY (BELOW)
BAGGAGE SUBWAY (BELOW)
STORAGE CLEANING & REPAIRING
LEXINGTON AVE. SUBWAY
MACHINERY
BOILER PLANT
AUXILIARY FACILITIES
SUBWAY
SUBSTATION
42ND
LEXINGTON
AVENUE
R LEVEL
SUBURBAN LEVEL


ST.
APARTMENT HOUSES
NT BUILDINGS
CONTRACT
AVENUE W.
AVENUE E.
RAILROAD Y.M.C.A.
LIGHTING ROTARY STA.
SUBSTATION
50TH ST. POWER PLANT
ASH ROOM
DRIVEWAY
ASH ROOM

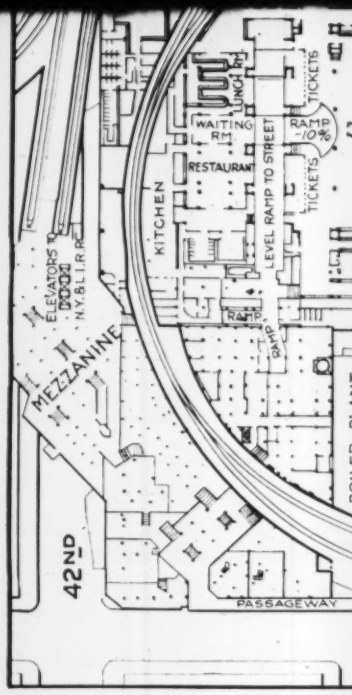


Grand Central Passenger Ter

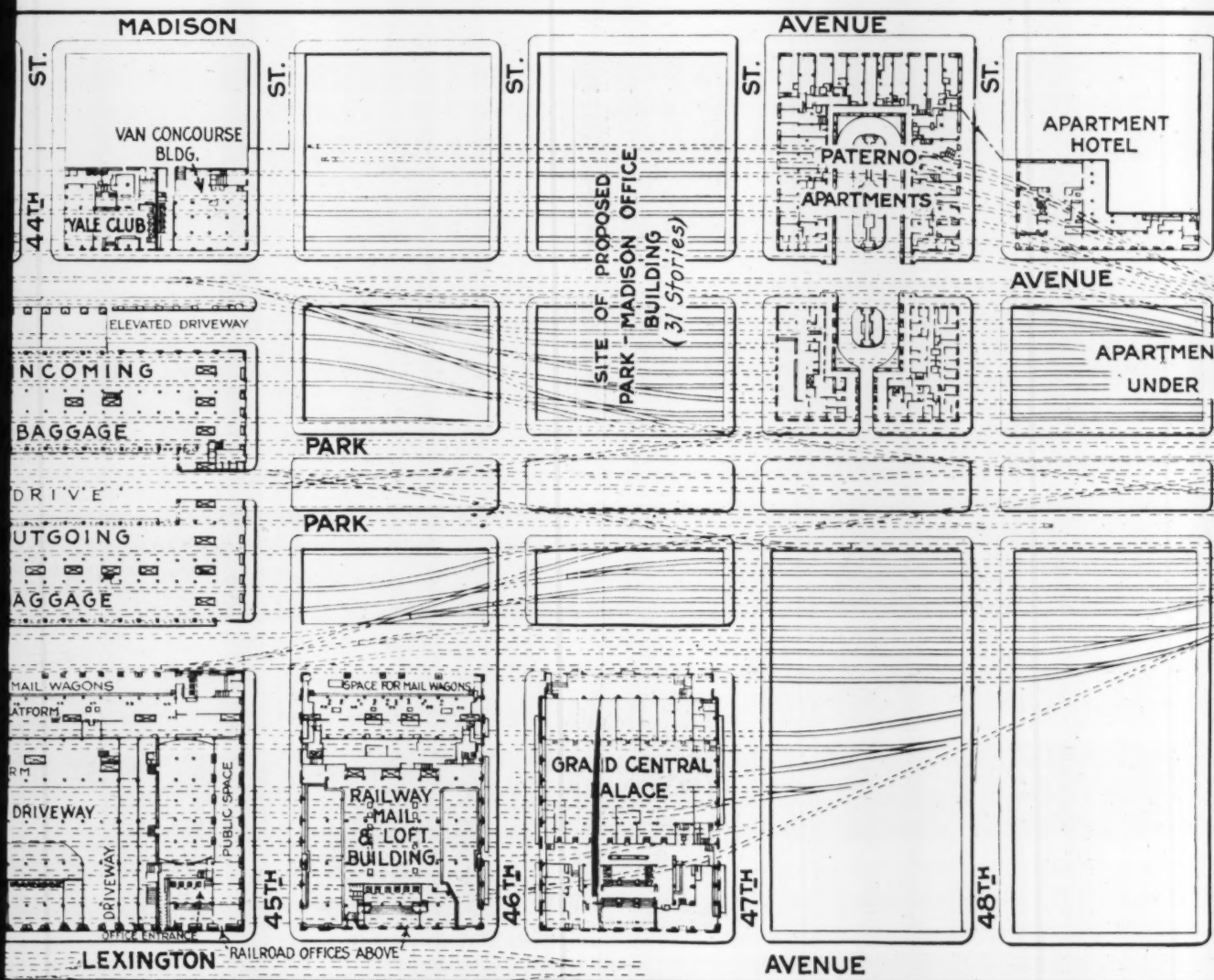
Four Levels Reproduced from M



CONCOURSE - UPPER LEVEL



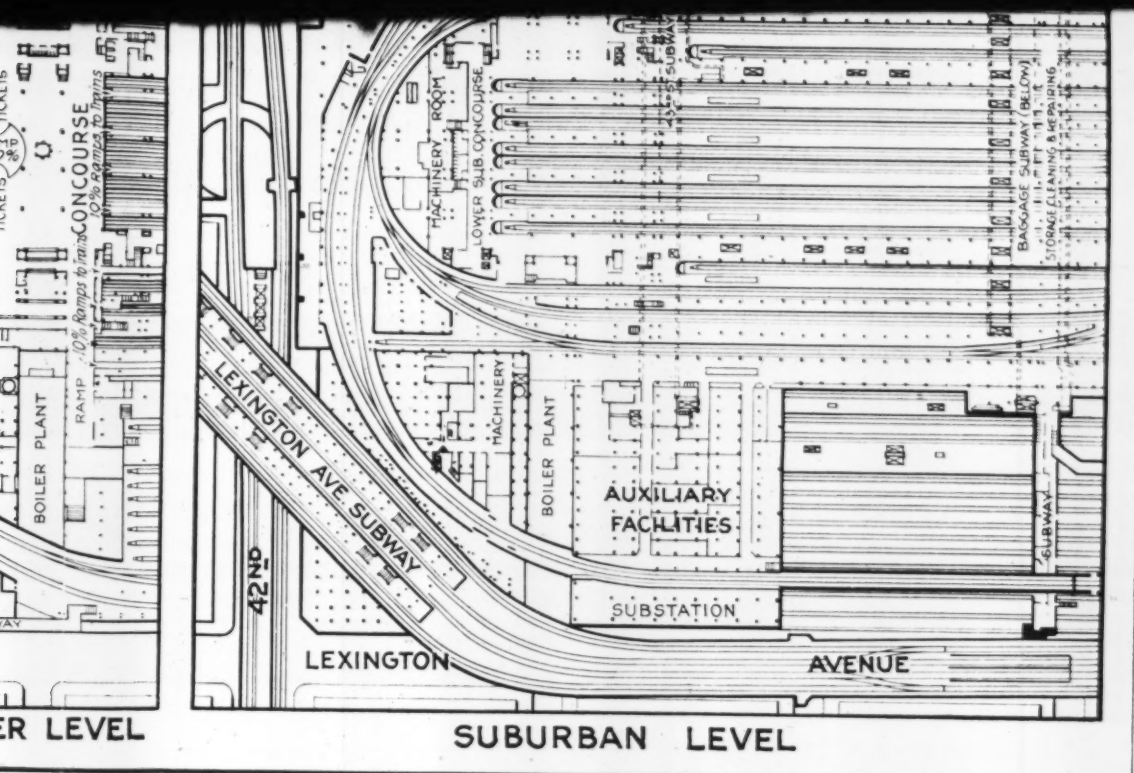
CONCOURSE - LOWER

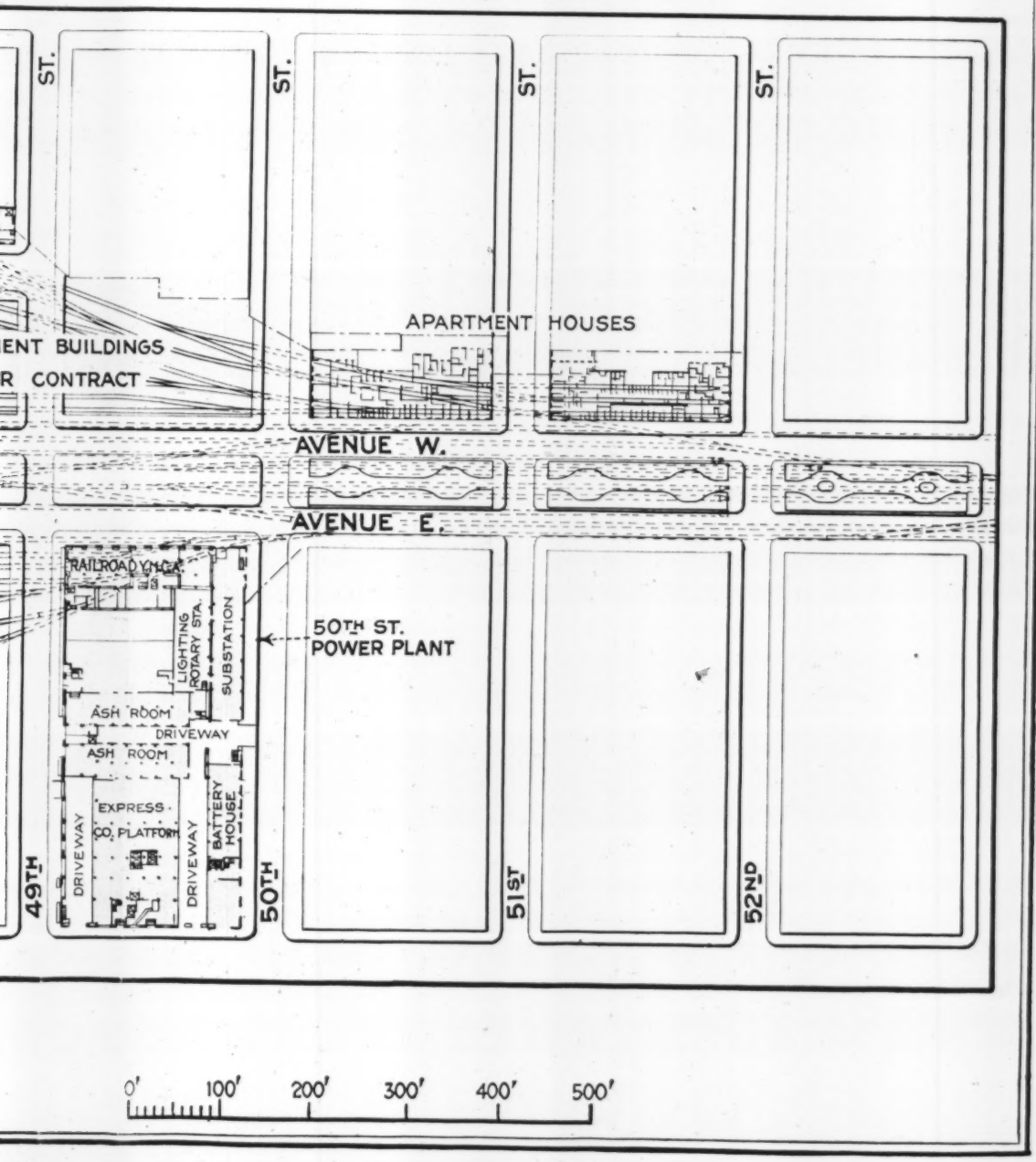


STREET LEVEL - TRACK LAYOUT OF EXPRESS LEVEL

d Central Passenger Terminal and Adjacent Property, New York C

Four Levels Reproduced from Most Recent "Layman's Maps" of New York Central Railroad


CONCOURSE
RAMP
BOILER PLANT
MACHINERY ROOM
LOWER SUB CONCOURSE
BAGGAGE SUBWAY (BELOW)
STORAGE CLEANING & REPAIRING
LEXINGTON AVE. SUBWAY
MACHINERY
BOILER PLANT
AUXILIARY FACILITIES
SUBWAY
42ND
SUBSTATION
LEXINGTON
AVENUE
ER LEVEL
SUBURBAN LEVEL


ST.
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APARTMENT HOUSES
ENT BUILDINGS
R CONTRACT
AVENUE W.
AVENUE E.
RAILROAD Y.M.C.A.
LIGHTING ROTARY STA.
SUBSTATION
50TH ST. POWER PLANT
ASH ROOM
DRIVEWAY
ASH ROOM
EXPRESS CO. PLATFORM
DRIVEWAY
BATTERY HOUSE
DRIVEWAY
49TH
50TH
51ST
52ND
0'
100'
200'
300'
400'
500'

City

and design, Michigan Agricultural College; secretary-treasurer, J. A. Herzog, chief draftsman, Reo Motor Car Co. There are 109 charter members in the chapter and some 40 additional applications are now under consideration. F. D. Messenger, road engineer of the State Highway Department, is chairman of the membership committee. The club will begin an intensive membership campaign in the near future in conjunction with the membership campaign of the national association.

The Engineers' Club of San Francisco, at a luncheon, Sept. 1, was addressed by Dr. Hermann Von Schrenk of the firm of Von Schrenk & Kammerer, consulting timber engineers, St. Louis, on "Proper and Improper Uses of Preserved Timber."

PERSONAL NOTES

DRURY BUTLER, surveyor Sacramento, County, Cal., has been appointed county engineer.

ERNEST E. TRIMBLE, engineer with the Union Pacific R.R., has been employed as full-time secretary of the Nebraska State Assembly of the American Association of Engineers, with headquarters in Omaha.

COL. EDWARD G. WALTON, stationed at Washington, D. C., Lt.-Col. Fidelio G. Chamberlain, at San Antonio, and Lt.-Col. Ira L. Fredenall, at San Francisco, have been appointed officers in charge of the district headquarters of the Construction Service in those cities.

JOHN BARRETT has retired as director general, Pan American Union, after nearly fourteen years in that capacity and twenty-five in official international service. After assisting in the organization of the new Pan American College of Commerce at Panama, as president of the Administrative Council, with headquarters at Washington, D. C., he will establish connections in Washington, Chicago and New York and at points on the Pacific coast and in the south, as a general counselor and special adviser in international, economic, commercial, financial and cultural relations. He is succeeded by Dr. L. S. Rowe.

MAJOR ROGER G. POWELL, who has been acting as assistant engineer commissioner during the drawing up of the Washington, D. C., zoning regulations, has been ordered to duty as assistant to Gen. Harry Taylor, who is in charge of the river and harbor work of the Corps of Engineers.

D. H. GOODWILLIE, director of public service and superintendent of water, Toledo, has resigned to become associated with the Edward Ford Plate Glass Co., Rossford, Ohio. He has been connected with the engineering and water departments of Toledo for nine years. Immediately following the construction of the filter plant he became chemist in charge of operation for four years. For a year he was an associate of W. G. Clark, consulting engineer, Toledo, and then returned to the city for three years as superintendent of water-works, a position he has retained for the past two years along with his duties as service director.

C. H. R. FULLER, of Toronto, has been appointed city engineer of Chatham, Ont., succeeding Frank P. Adams.

A. A. POTTER, dean of the School of Engineering, Kansas State Agricultural College, has resigned to become dean of the School of Engineering, Purdue University. He will be succeeded by Roy A. Seaton, recently professor of mechanical engineering at Kansas State Agricultural College.

GEORGE C. WHIPPLE, recently chief of sanitation of the League of Red Cross Societies, Geneva, Switzerland, has been appointed consulting sanitary engineer to the League. He will return to New York about Sept. 20.

G. M. WILLIAMS, who has been for a number of years a specialist in the cement investigations of the U. S. Bureau of Standards, has resigned to become assistant professor of civil engineering, University of Saskatchewan.

L. V. BEAN has been appointed chief engineer of the roadway department of the Georgia, Florida & Alabama Ry., with headquarters at Bainbridge, Ga.

M. F. STEINBERGER has become special engineer on the staff of the vice-president in charge of operation and maintenance of the Baltimore & Ohio R.R., with headquarters at Baltimore.

H. M. BLOMQUIST, principal assistant engineer, water department, St. Paul, Minn., has been appointed superintendent of the Cedar Rapids, Iowa, water-works system. Previous to going to St. Paul, Mr. Blomquist was for several years city engineer of Mankato, Minn.

P. F. WRIGHT, chief draftsman, U. S. Department Engineer's Office, Charleston, S. C., has been transferred to the office of the District Engineer at Baltimore, Md.

FREDERICK S. WHEELER, formerly resident engineer of the California State Highway Commission, is now associated with the efficiency engineer, producing department, Standard Oil Co., Delano, Cal.

A. W. KREAMER, formerly assistant engineer for the United States War Department, stationed at Wheeling, W. Va., is now with Stone & Webster, Inc., engaged as assistant engineer on appraisal work and designer on structural steel and reinforced concrete work.

A. C. LAGERWALL has become engineer of Shawnee County, Kan. with headquarters at Topeka, succeeding J. E. Williams. Mr. Lagerwall has recently been engineer on Federal Aid Project No. 7 in Douglas County.

OBITUARY

ERNEST VOSS, a well-known shipbuilder of Germany, died recently at Hamburg, at 78 years of age. Mr. Voss obtained his experience with English shipbuilding firms and was afterward engineer and surveyor to Lloyd's Register in Germany. He was one of the founders, in 1876, of the firm of Blohm & Voss, which concern, among many other notable productions in war vessels and merchant ships, built the "Vaterland."

WILLIAM HARLEY MOORE, bridge engineer of the New York, New Haven & Hartford R.R., died Sept. 5 at New Haven, Conn., at 60 years of age. Mr. Moore received his education in the Royal University of Ireland. After about a year's service as draftsman with the New York Central & Hudson River R.R., and three years in a similar capacity on the New York, New Haven & Hartford R.R., he was made bridge engineer of the latter road, in 1889, which position he held up to the time of his death.

BENJAMIN SMITH LYMAN, geologist and mining engineer, died at Philadelphia Aug. 30. He was born in Northampton, Mass., Dec. 11, 1835. He graduated from Harvard University in 1855, and studied mining engineering at Ecole des Mines, Paris, and the Royal Academy of Mines, Freiberg. He was mining engineer for the Public Works Department of India in 1870, engaged in the survey of oil fields, and from 1873 to 1879 acted as chief geologist and mining engineer to that government. He traveled extensively in Europe, India, China and the Philippines, making geological researches, and was the author of more than 150 papers on geological surveying.

DR. WILLIAM H. ELLIS, former Dean of the Faculty of Applied Science, University of Toronto, died Aug. 23 at Lake Joseph, Muskoka, Can., where he was spending his vacation. He was born in England, in 1845, and graduated at the University of Toronto. In 1878 he became assistant professor of chemistry in the Toronto School of Practical Science, and when that institution became the School of Applied Science and Engineering of the University Dr. Ellis was appointed professor of applied chemistry and head of the department of chemistry. He became dean of the faculty in 1914, from which position he retired last year. During his occupancy of this chair a School of Engineering Research was founded, largely through his efforts. He held the degree of L.L.D from both Toronto and McGill Universities and a few years ago the Engineering Institute of Canada elected him one of its honorary members. Dr. Ellis was for many years provincial analyst of Ontario.